Vol. XI.—No. 52.] [MAY, 1897.

THE

MINERALOGICAL MAGAZINE

AND

JOURNAL

OF THE

Mineralogical Society.

INSTITUTED 3rd FEBRUARY, 1876.

EDITED BY H. A. MIERS, M.A., F.R.S.,

Reprinted 1965 for
Wm. DAWSON & SONS LTD., LONDON
with the permission of
THE MINERALOGICAL SOCIETY

Mineralogical Society.

OFFICERS AND COUNCIL FOR 1896-97.

PRESIDENT.

PROFESSOR N. STORY-MASKELYNE, M.A., F.R.S.

PAST-PRESIDENTS.

H. C. SORBY, LL.D., F.R.S. 1876–1879.
PROF. M. F. HEDDLE, M.D., F.R.S.E. 1879–1881.
W. H. HUDLESTON, M.A., F.R.S. 1881–1883.
REV. PROF. T. G. BONNEY, D.Sc., F.R.S. 1883–1885.
L. FLETCHER, M.A., F.R.S., 1885-1888.
R. H. SCOTT, M.A., F.R.S., 1888-1891.

VICE-PRESIDENTS.

REV. PROF. S. HAUGHTON, M.D., F.R.S.
HUGO MÜLLER, Ph.D., F.R.S.

TREASURER.

F. W. RUDLER, F.G.S., 28 Jermyn Street, London, S.W.

GENERAL SECRETARY.

L. FLETCHER, M.A., F.R.S., 36 Woodville Road, Ealing.

FOREIGN SECRETARY.

PROF. J. W. JUDD, C.B., F.R.S.

PROF. J. GEIKIE, LL.D., F.R.S.
A. HUTCHINSON, Ph.D., F.C.S.
B. KITTO, F.G.S.
LIEUT.-GEN. C. A. McMAHON, F.G.S.
A. HARKER, M.A., F.G.S.
A. E. TUTTON, A.R.C.S., F.C.S.
W. W. WATTS, M.A., F.G.S.
PROF. W. J. LEWIS, M.A., F.C.S.
W. BARLOW, F.G.S.
PROF. A. H. CHURCH, M.A., F.R.S.
PROF. H. A. MIERS, M.A., F.R.S.
W. J. POPE, F.C.S.

TRUSTEES.

PROF. N. S. MASKELYNE, M.A., F.R.S.
R. H. SCOTT, M.A., F.R.S.

AUDITORS.

B. KITTO, F.G.S.
J. H. COLLINS, F.G.S.

LIBRARIAN.

PROFESSOR W. J. LEWIS, M.A., F.C.S., The New Museums, Cambridge,
(to whom all publications intended for the Library of the Society should be forwarded).

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, November 17th, 1896.

Dr. Hugo Müller, F.R.S., Vice-President, in the Chair.

The death of Professor A. H. Green, F.R.S., Member of the Society, was announced.

Mr. Thomas Henry Holland, F.G.S., A.R.C.S., Superintendent of the Geological Survey of India, was elected an Ordinary Member of the Society.

ANNIVERSARY MEETING.

Held in the Apartments of the Geological Society, November 17th, 1896.

Dr. Hugo Müller, F.R.S., Vice-President, in the Chair.

Twelve Members and two visitors were present.

The following Report of Council for the Session 1895-6 was read by the Secretary :—

REPORT.

The Balance Sheet for the year ending December 31st, 1895, which was issued with Number 51 of the Journal, showed that the state of the Finances of the Society continued to be very satisfactory : the Assets (exclusive of the Stock of the Journal and the Library) amounting to £460 17s. 4d., and the only Liability being £1 6s. 5d. (for postage). The number of existing Members who had compounded before December 31st, 1895, for their Annual Subscription, was 34.

During the Session 1895-6, one Ordinary Member (Professor Green), and one Corresponding Member (Professor Daubrée), have been removed by death ; two new Members, Messrs. Wills and Holland, have been elected, and two Members, Messrs. Hall and V. Hughes have resigned. The number of Members of the Society is now 130 : of these, 109 are Ordinary Members and 21 are Corresponding Members.

Four Meetings have been held during the year, all in London, and (by kind permission) in the Apartments of the Geological

Society, Burlington House. The attendances at these Meetings have been 14, 17, 13 and 17, respectively.

Two Numbers of the Journal have been issued since the last Anniversary Meeting. The first of these is an Index of Authors and Subjects for the ten volumes of the Journal which have now been published : the preparation of the Index, which extends to 88 pages of closely printed matter, was undertaken as a labour of love by Mr L. J. Spencer, to whom the hearty thanks of the Society are due. The other, Number 51, contains papers by Mr. Barlow, Professor Lewis and Lieut.-Gen. C. A. McMahon. Mr. Barlow's paper deals with homogeneous structures and the symmetrical partitioning of them, with application to crystals; it is accompanied by two elegant plates by the help of which illustrative models can be constructed for the use of the reader : the paper will be very acceptable wherever crystallography is deeply studied. Professor Lewis's paper on the Humite Series suggests various points of morphological similarity of the members of that series to one another and to olivine and enstatite. Lieut.-Gen. McMahon's paper is descriptive of a biotite-cyanite-cordierite rock, from the Upper Satlej Valley, in the North-West Himalayas, and discusses the mode of origin of such a rock. The same number contains a useful series of Abstracts for which the Society is indebted to Messrs. Harker, Prior and Spencer.

During the year the Stock of the Journal has been transferred to the custody of the Secretary, and the Insurance has been dropped.

The Council has to congratulate the Society on the continued steady sale of the Journal.

On the motion of the Chairman, seconded by Professor Miers, the Report of the Council was adopted.

Mr. Kitto and Mr. Pringle, having been nominated by the Chairman to act as scrutineers, reported that 31 voting papers had been returned, and that the following list of Officers and Council had been unanimously approved.

President.	Prof. N. S. Maskelyne, F.R.S.
Vice-Presidents.	Rev. S. Haughton, M.D., F.R.S.
	Dr. Hugo Müller, F.R.S.
Treasurer.	Mr. F. W. Rudler, F.G.S.
General Secretary.	Mr. L. Fletcher, F.R.S.
Foreign Secretary.	Prof. J. W. Judd, F.R.S.
Ordinary Members of Council.	Mr. W. Barlow, F.G.S.
	Prof. A. H. Church, F.R.S.
	Prof. J. Geikie, F.R.S.
	Mr. A. Harker, F.G.S.
	Mr. A. Hutchinson, F.C.S.
	Mr. B. Kitto, F.G.S.
	Prof. W. J. Lewis, F.C.S.
	Prof. H. A. Miers, F.R.S.
	Lieut.-Gen. C. A. McMahon, F.G.S.
	Mr. W. J. Pope, F.C.S.
	Mr. A. Tutton, F.C.S.
	Mr. W. W. Watts, F.G.S.

Mr. J. H. Collins and Mr. B. Kitto were elected Auditors of the accounts of the Society.

Votes of thanks to the Geological Society for the use of its Apartments and to the retiring Members of Council were carried with acclamation.

The following papers were then read:—

1. Notes on the analysis of Zirkelite and Derbylite: by Mr. Prior (pp. 176, 180).

2. On some crystals of Iron Pyrites from Cornwall: by Mr. Hutchinson.

3. *a.* Zinckenite and Wolfsbergite (Chalcostibite) from Wolfsberg in the Harz: and the Zinckenite Group (p. 188).

b. The Crystallography of Plagionite: new crystal forms on Stephanite, Enargite and Anglesite (p. 192): both by Mr. Spencer.

4. Discovery of Prehnite in Wales: by Mr. Harrison, communicated by Prof. Miers (p. 198).

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, February 2nd, 1897.

N. S. Maskelyne, Esq., F.R.S., President, in the Chair.

Mr. Wm. Phipson Beale, Q.C., F.G.S., F.C.S., was elected a Member of the Society.

GENERAL MEETING.

Held in the Apartments of the Geological Society, February 2nd, 1897.

N. S. Maskelyne, Esq., F.R.S., President, in the Chair.

Eleven Members and one visitor were present.

The following papers were read:—

1. Note on Altaite from Burma: by Professor Henry Louis, M.A., F.G.S. (p. 215).

2. On Nemalite from Afghánistán: by Mr. F. R. Mallet, F.G.S. (p. 211).

3. On Derbylite, a new mineral from Brazil: by Dr. E. Hussak and Mr. G. T Prior (p. 176).

4. On Homogeneous Structures and Circular Polarisation: by Mr. William Barlow, F.G.S.

5. On Crystals of Calcite from Cleator Moor: by Mr. A. Hutchinson, Ph.D., F.C.S.

Mr. Barlow showed a model in illustration of his paper.

A small mass of a new meteoric iron, a large facetted beryllonite, and a fragment of pyrope showing an enclosed crystal of peridot were exhibited by Mr. W. E. Hidden.

EXCERPT MINUTES OF COUNCIL MEETING.

Held in the Apartments of the Geological Society, April 6th, 1897.

N. S. Maskelyne, Esq., F.R.S., President, in the Chair.

The audited Balance Sheet for the year ending December 31st, 1896, was submitted and approved: the Secretary was instructed to insert it in the Minutes as usual, and to issue a printed copy with the next Number of the Journal.

Mr. G. F. Herbert Smith and Mr. H. L. Bowman were elected Members of the Society.

The date of the next Meeting was changed from June 22nd (General Holiday) to June 17th.

Prof. Miers and Mr. Spencer were appointed to assist in the classification of mineralogy for the proposed International Catalogue of Scientific Literature.

GENERAL MEETING.

Held in the Apartments of the Geological Society, April 6th, 1897.

N. S. Maskelyne, Esq., F.R.S., President, in the Chair.

Fourteen Members and one Visitor were present.

The following papers were read :—

1. On a new occurrence of Apophyllite in South Africa : by Mr. J. A. L. Henderson, M.E.

2. On Webnerite from Hungary : by Mr. G. T. Prior and Mr. L. J. Spencer.

3. On the Indexing of Mineralogical Literature : by Prof. Miers.

4. Some simple names for the 32 types of Crystal-symmetry : by Prof. Miers.

5. On Epidote from the Mourne Mountains : by Mr. A. Hutchinson.

Prof. Le Neve Foster exhibited a garnet enclosing a crystal of diamond found in the Orange Free State, and Prof. Miers a new form of horizontal-goniometer for the use of Students.

Mineralogical Society—Abstract of Receipts and Payments from 1st January to 31st December 1896.

RECEIPTS.

	£ s. d.	£ s. d.
Balance from year 1895		82 7 5½
Subscriptions:—		
(1) In advance	1 1 0	
(2) Current	40 19 4	
(3) In arrear	5 5 0	
		47 5 4
Entrance Fees and Compositions		23 2 0
Sale of Publications:		
(1) From Publishers (two years) ...	41 14 4	
(2) In Office...	0 19 1½	
		42 13 5½
Dividends on Stock		8 16 0
		£204 4 3

PAYMENTS.

	£ s. d.	£ s. d.
Printing and Stationery		77 5 6
Illustrations		5 6 3
Purchase of Serials to complete series		7 8 4
Attendance at Meetings		1 1 0
Insurance of Stock for three months		1 11 3
Carriage on removal of Stock		0 8 6
Secretarial Postage (two years)		2 7 5
Commissions on Cheques		0 2 0
Investments and Commission		58 16 0
Balance at Bank	£49 12 8	
,, in Office	0 5 4	
		49 18 0
		£204 4 3

Examined and compared with the vouchers and found correct. (Signed)

March 10*th*, 1897.

BENEDICT KITTO, J. H. COLLINS, } *Auditors.*

LIABILITIES.

	£ s. d.
Printing	3 7 8
Binding	19 0 9
Periodicals	0 13 0
Excess of Assets over Liabilities	474 19 6
	£498 0 11

The number of Life Members on December 31st, 1896, was 39.

ASSETS.

	£ s. d.
Balance as above	49 18 0
Subscriptions for 1894-6 unpaid	22 0 0
Stock in 2¾ Consols: £347 6s. 7d. at 112	389 3 2
Dividend on Stock, January 1897	2 6 2
Sale of Journal due from Publishers	25 7 0
Due for Authors' Copies	9 6 7
	£498 0 11

MEMO.—The Stock of Publications and the Library are not included in the above assets.

(Signed) F. W. RUDLER,

Treasurer.

THE MINERALOGICAL MAGAZINE

AND

JOURNAL

OF THE

MINERALOGICAL SOCIETY.

No. 52. MAY 1897. Vol. XI.

Note on the Occurrence of Rocks allied to Monchiquite in the Island of Fernando Noronha.

By G. T. Prior, M.A., F.G.S., Assistant in the Mineral Department of the British Museum.

[Read February 4th, 1896.]

THE name of Monchiquite, first applied by Rosenbusch and Hunter (*Tscherm. Min. Mitth.* XI. 1890, p. 445) to a peculiar group of dyke rocks found in association with elæolite-syenite in Brazil, is rapidly becoming familiar to petrologists through the discovery of similar rocks from various other localities.

The Brazilian Monchiquites were described by Rosenbusch as black to grayish-black rocks, consisting of porphyritic olivine and pyroxene, with widely varying amounts of hornblende and mica, in a glassy[1] base usually crowded with hornblende microliths.

[1] Recently (*Journ. Geol.* IV. 1896, No. 6) L. V. Pirsson has brought forward evidence to show that the supposed glassy base in these rocks really consists of analcite.

In the United States similar rocks have been found in many localities, where they occur associated with elæolite-syenite as in Brazil. Rocks belonging to this type in Arkansas were divided by J. F. Williams into Monchiquites proper, containing olivine, and two varieties free from olivine, fourchite (containing augite and hornblende), and ouachitite (containing biotite, or biotite and hornblende). In Arkansas, the Lake Champlain district, and near Montreal, as well as in Brazil, the Monchiquites occur in association with rocks of great geological age. This group, however, is not confined to the older rocks. In the Bohemian Mittelgebirge rocks which are referred to Monchiquite by Rosenbusch occur as dykes in association with the Tertiary phonolites and nepheline basalts. Many of these rocks have been recently investigated by Hibsch (*Tscherm. Min. Mitth.* XIV. 1894, p. 95; and XV., 1895, p. 201.) They were originally described, however, more than 20 years ago by Boricky (*Petrog. Studien a. d. Phonolithgesteinen Böhmens*, 1873; and *Petrog. Studien a. d. Basaltgesteinen Böhmens*, 1874) under the name of trachybasalts. According to Boricky they occur in the form of wall-like dykes, 1 to 3 feet wide, in the phonolites of the north part of the Bohemian Mittelgebirge between Aussig and Tetschen, and are the youngest eruptive rocks in the district. He divides them into three groups, according to the prevalence in them of felspar, nepheline (leucite) and nosean; but all are characterised by a peculiar type of microstructure, viz. the interlacing hornblende microliths in a more or less glassy base. They are mostly free from olivine, and can therefore be referred to the fourchite variety of Williams.

It is to these trachybasalts of Boricky that the rocks from Fernando Noronha, which are the subject of the present note, present the most striking similarities both in character and mode of occurrence. The rocks in question form part of a collection made by Mr. H. N. Ridley during his stay upon the island of Fernando Noronha in 1887 (see *Journ. Linn. Soc.* XXVII. 1891, p. 1). For some of these specimens there is no record of their mode of occurrence; but in the case of the specimens from Sponge Bay, on the south-east side of the main island, it is clearly stated in Mr. Ridley's notes that they occurred as dykes, up to 3 feet in width, running down from the East Hills (Morro Francez) to the sea, and traversing beds of phonolitic tuff. Examination of the sections of some of these rocks suggested at once comparison with the sections of Boricky's trachybasalts in the British Museum collection.

The specimens collected between Cotton Tree Bay and Look-out Hill (Atalaia Grande) in section most resemble the Bohemian rocks. One

variety (specimens numbered 67 106, −112, −116, −117) is a gray rock, showing to the naked eye, in a dense groundmass, porphyritic prismatic crystals of hornblende and augite. Under the microscope the groundmass is seen to consist of a colourless base (mainly isotropic, but in patches feebly depolarising), which is densely crowded with long microliths of augite and brown hornblende, often arranged in radiating groups, and with small magnetites. The phenocrysts are long prismatic deep reddish-brown hornblendes, generally twinned, and prismatic purple pleochroic augites, often with green or colourless centres. Nosean in hexagonal sections also occurs; but in these specimens the mineral has suffered zeolitic alteration. Included in the hornblendes and augites are octahedra of magnetite, and apatite in needles or in clear sharply-defined hexagonal sections.

Another variety from the same locality (No. 67113) is a dense black glassy-looking rock, showing porphyritic crystals of hornblende and augite. Under the microscope it is seen to be much more like the preceding variety than the hand specimen would suggest. The phenocrysts are the same, viz. hornblende and augite with magnetite, apatite and nosean. In this case the latter mineral is quite fresh and perfectly isotropic, while many of the hexagonal sections show the characteristic inclusions. In the groundmass, which has the appearance of being a more perfect glass (but see Pirsson, *loc. cit.*) than in the preceding rock, the microliths are much more minute, and show flow structure. In a petrographical paper (*Am. J. Sci.* 37, 1889, p. 178) by G. H. Williams, on a collection of rocks from Fernando Noronha made by J. C. Branner in 1876, the augitite (No. 115) from the tuff east of Morro Francez, according to the description, closely resembles the above rock, except that it contains nepheline instead of nosean.

A third variety (No. 67111), occurring as a dyke at the base of Look-out Hill (Atalaia Grande), is a black glassy-looking rock with porphyritic augites and brown patches of altered olivine. Under the microscope it is seen to differ from the rocks described above by the absence of phenocrysts of hornblende and nosean, and by the presence of olivine. The only phenocrysts are large purple zoned augites and altered olivines. These occur in idiomorphic crystals in an extremely dense groundmass, which is almost opaque except in the thinnest possible sections, and consists of an isotropic base, densely crowded with magnetite and minute microliths of augite and hornblende.

The specimens (Nos. 67063 and 67081) from the dykes at Sponge Bay which run down from the East Hills (Morro Francez) to the sea, closely

resemble the rock (No. 14) described by G. H. Williams *(loc. cit.)* as limburgite, which occurred as a dyke at the base of Atalaia Grande. They are dense black glassy-looking rocks showing porphyritic crystals of augite and hornblende with brown patches of altered olivine. Under the microscope the groundmass is seen to consist of an isotropic base, crowded with long microliths of hornblende and augite, with much magnetite. The phenocrysts are mostly augites in prismatic crystals, green in the interior with purplish brown borders. Hornblende crystals are not numerous, but are large with corroded borders, and in some cases they enclose augites. A characteristic feature of the rock is the numerous hexagonal sections of beautiful blue hauyne. Olivine occurs sparingly in altered crystals.

The rocks above described have all been characterised by the absence of felspar. A specimen (No. 67072), however, from a dyke at Sponge Bay, traversing phonolite, shows the presence of felspar in the groundmass. It is a dense black rock not markedly porphyritic, in parts minutely vesicular. Under the microscope the phenocrysts are seen to consist almost entirely of augites, having the same characters as in the preceding rocks, except that they are not so prismatic and vary in size so that the rock is not so distinctly porphyritic. Besides the augite, deep brown hornblende phenocrysts occur sparingly, and a few small altered olivines. The base is in parts isotropic, and in parts consists of lath-shaped felspars: it is crowded with deep brown hornblende microliths with magnetite and small purplish augites.

A specimen (No. 67083) from the hill above Sponge Bay, and another from Morro Branco (67125), approach more nearly to felspar-basalts. In external aspect they are very similar to the rock (No. 67106) first described, and show large porphyritic crystals of hornblende and augite in a light gray groundmass. In section the groundmass is seen to consist of an isotropic base containing small lath-shaped felspars, granular augite and much magnetite. The phenocrysts are large prismatic augites and hornblendes, sometimes intergrown.

In the present note only a brief account of this group of rocks has been given, mainly with the view of pointing out the analogies which they present in character and geological occurrence with the Tertiary igneous rocks of the Bohemian Mittelgebirge. In both localities we have these Monchiquite dykes associated with phonolites and nepheline-basalts. In Fernando Noronha the relative age of phonolite and nepheline-basalt has not been satisfactorily made out. Professor Branner was unable to come to any definite conclusion on this point. Mr. Ridley, from the

appearance of alteration of phonolite by basalt in certain localities, considered that the phonolite was anterior to the basalt. It may be pointed out, however, that the localities he mentions (Look-out Hill, Morro Branco) are just those in which Monchiquites occur, and that the basalts he speaks of may belong to these exceptional rocks rather than to the nepheline-basalts which constitute the prevailing rocks of the island. As in Bohemia, so in Fernando Noronha, the phonolite is found occupying the prominent peaks (Mount St. Michael, the Peak, Atalaia Grande, etc.), and has the appearance of having been injected into older rocks. We are inclined, therefore, to venture the opinion that the sequence of the rocks in Fernando Noronha will be found to be the same as in the Bohemian Mittelgebirge, viz. nepheline-basalt, phonolite, trachybasalt, and that in both localities these youngest Monchiquite dykes represent the later stages in the differentiation of an elæolite-syenite magma.

In a future paper I hope to give a more detailed account of these and other rocks from Fernando Noronha, and to supplement that account with analyses of the principal types.

On Derbylite, a new Antimono-titanate of Iron, from Tripuhy, Brazil.

By Dr. E. Hussak, of the Geological Survey of S. Paulo; and
G. T. Prior, M.A., F.G.S., Assistant in the Mineral Department of the British Museum.

[Read February 2nd, 1897.]

A BRIEF notice of this new mineral, which was found associated with Lewisite in the cinnabar-bearing sands of Tripuhy, near Ouro Preto, Minas Geraes, Brazil, has already been given by the authors in *Min. Mag.* Vol. XI. No. 50, p. 85. Since that time a sufficient amount of material (1½ grms.) has been separated from the sand to permit a more detailed investigation of its crystallographic and chemical characters.

Crystallographic and other physical characters (E. H.).

Derbylite crystallises in the orthorhombic (holohedral) system.

Axial ratios: $a : b : c = 0{\cdot}96612 : 1 : 0{\cdot}55025$.

Fundamental angles: $100 : 110 = 44° 0' 45''$.

$001 : 011 = 28° 49' 18''$.

Observed forms: $\infty P(110)$ *m*, $\infty \bar{P}\infty (100)$ *a*, $0P(001)$ *c*.

The prism faces are very smooth and brilliant, while the macropinacoid is for the most part rough. The rare basal plane is always uneven and arched, and a conchoidal fracture parallel to this plane is frequently observed. Terminal faces are lacking, and the inclination 001 : 011 is calculated from the twinning law.

Twinning (see Figure) is frequent, giving staurolite-like contact and intergrowth forms according to the law:—twinning plane a face of (011), whereby the vertical axes of the two individuals cross at an angle of 57° 38′ 36″, and the macropinacoids of both individuals fall into the same plane; the angle between two adjacent prism faces of the two individuals was measured as 39° 8′ 25″. From these angles the value of 001 : 011 was calculated as 28° 49′ 18″.

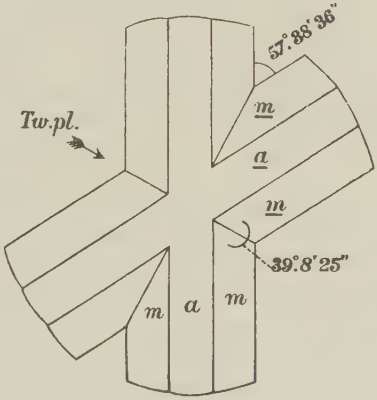
Triplets according to the same law also occur, but are rare.

Colour: pitch black, translucent in thin splinters, with a dark brown tint.

Lustre: resinous, especially well shown on fractures parallel to 001.

Hardness: about 5, not determinable with exactness on account of the minuteness of the crystals and their extreme brittleness, due to the conchoidal fracture parallel to 001.

Optical Properties. These also proved indeterminable in the thinnest section which could be prepared by the well-known firm of Voigt and Hochgesang in Göttingen. The mineral is translucent in extremely thin splinters only, and on these the only points determinable were that it is biaxial, and not notably pleochroic.



Specific Gravity (G. T. P.). A determination made with a 3cc. pyknometer upon 0·7549 grm. gave as the weight of 1cc. at 18°, 4·530. Two previous determinations made on different samples in much smaller amount (0·1121 grm. and 0·1945 grm. respectively) gave 4·529 and 4·512.

Chemical Characters (G. T. P.).

Derbylite is insoluble in acids, but is decomposed by fusion with acid sulphate of potassium. With salt of phosphorus it gives in the reducing flame a bead, yellow when hot, violet when cold.

Two quantitative analyses have been made. For the preliminary analysis, No. I., only 0·1281 grm. was available; for the second, more complete, analysis, No. II., 0·5263 grm. was used. Unfortunately the material for the analyses could not be completely freed from a white adhering impurity.

Result of Analyses.

I.		II.		Molecular Ratios.
Sb_2O_5	19·0	Sb_2O_5	24·19	·075
TiO_2	35·8	TiO_2	34·56	·420
SiO_2	3·1	SiO_2	3·50	·058
		Al_2O_3	3·17	·031
FeO	33·9	FeO	32·10	·447
CaO	0·4	CaO	0·32	·006
		Na_2O	0·76	·012
		K_2O	0·28	·003
Loss on ignition	0·5	Loss on ignition (from I.)	[0·50]	
Undetermined (partly loss of Sb_2O_5)	(7·3)			
	100·0		99·38	

If the SiO_2, Al_2O_3 and alkalies be not regarded as essential constituents but as due to impurity, the simplest formula *suggested* by the numbers obtained in Analysis II. is $FeO.Sb_2O_5 + 5\ FeO.TiO_2$.

Method of Analysis. In both analyses the mineral was decomposed by heating in a current of hydrogen. The reduced material was digested with a mixture of nitric and tartaric acids, to which hydrochloric acid was added later in order to expel the nitric. A considerable amount of a black residue remained undissolved. This consisted mainly of Ti_2O_3, but retained some iron and antimony. In the preliminary analysis the insoluble residue was collected on a filter and was afterwards ignited, so that some loss of antimony certainly occurred. In the second analysis, therefore, the insoluble residue was transferred to a silver crucible and fused with caustic soda. The product was dissolved in a mixture of hydrochloric and tartaric acids, and treated separately from the original solution, though in a similar way. The antimony was precipitated by sulphuretted hydrogen, and the iron in the filtrate by ammonium sulphide. After the destruction of the tartaric acid, the titanium was precipitated by ammonia and the calcium with ammonium oxalate. After weighing, the titanic acid mixed with silica and alumina was fused with acid potassium sulphate and the silica separated. The titanium in the solution was then precipitated by long continued boiling, and the alumina in the filtrate by ammonia.

Mode of occurrence of Derbylite (E. H.). The mineral was found in the cinnabar-bearing gravel of the fazenda Tres Cruzes, Tripuhy, near Ouro Preto, Minas Geraes, Brazil. The minerals accompanying it, including Lewisite, have been already noted in this Magazine (*loc. cit.*). The Derbylite was first found in loose crystals, from 2 to 3 mm. long, and in fragments of crystals, in the sand. The crystals had often intergrowths of muscovite on the ends of the prisms, being in this respect similar to Lewisite, which often shows inclusions of quartz grains and flakes of muscovite. Later observations prove that both minerals come from the thin bedded muscovite-schist which accompanies itabirite in the neighbourhood of Tripuhy, and recently both these titano-antimonates have been found *intergrown* with specular iron in fragments of this *muscovite-schist* found in the gravel.

The name of Derbylite has been given to the mineral after Orville A. Derby, Director of the Geographical and Geological Survey of the State of S. Paulo, Brazil, in commemoration of his great services in the Geology of Brazil.

On the Chemical Composition of Zirkelite.

By G. T. Prior, M.A., F.G.S.,

Assistant in the Mineral Department of the British Museum.

[Read November 17th, 1896.]

In a previous paper (*Min. Mag.* XI. 1895, p. 80), the result was given of an analysis of the new mineral, Zirkelite, which was discovered by Dr. Hussak in association with baddeleyite in the decomposing magnetite-pyroxenite of Jacupiranga, S. Paulo, Brazil.

In that analysis only a small amount of material (less than a quarter of a grm.) was used, and no very serious attempt was made to separate small percentages of rare earths in the main zirconia precipitate. The individual numbers also which resulted from an attempt to separate the titanium and zirconium by Bailey's hydrogen peroxide method were given provisionally, and stated to be regarded only as approximate. A subsequent examination of the precipitates showed that the mineral contained cerium, and that (owing mainly to the impurity and want of concentration of the hydrogen peroxide employed) the attempt at separating the titanium and zirconium had been a failure, so that the number giving the percentage of titanium was much too high. A note to this effect would have been inserted in this Magazine had no further material been available for analysis; but, fortunately, through the zeal of Dr. Hussak, a larger supply of the mineral was soon forthcoming, sufficient for the more complete analysis, of which the result is given below.

In this analysis only material which sank in thallium-silver nitrate was used.

A re-determination of the density, made on ·6893 grm. of such material, gave as the weight of 1cc. at 17° C. 4·741.

Result of Analysis :—

		Molecular ratios.
ZrO_2 =	52·89	·433
TiO_2 =	14·95	·182
ThO_2 =	7·31	·028
Ce_2O_3 =	2·52	·008
$(Y_2O_3?)$ =	0·21	·001
UO_2 =	1·40	·005
FeO =	7·72	·107
CaO =	10·79	·193
MgO =	0·22	·005
Loss on ignition (from preliminary analysis) =	1·02	
	99·03	

Weight of material used in analysis, 0·4716 grm. The molecular ratios correspond approximately to the formula $RO.2(Zr,Ti,Th)O_2$.

Method of Analysis.—The mineral (very finely powdered by grinding in an agate mortar and moistening with absolute alcohol) was decomposed by fuming hydrofluoric acid.[1] By diluting and filtering, a rough separation was at once effected between the soluble (Zr,Ti,Fe...) and the insoluble (Th,Ca,Ce...) fluorides. The solution (A) and the insoluble residue on the filter (B) were then treated separately.

(A) The solution was evaporated nearly to dryness, and the fluorides decomposed by sulphuric acid, the excess of which was removed by heating gently. On adding cold water, a clear solution was obtained. After nearly neutralising with sodium carbonate, the Zr and Ti were precipitated by sodium thiosulphate, and the Fe in the filtrate, after separating sulphur, by ammonia. After weighing, the mixed ZrO_2 and TiO_2 were again brought into solution, and the TiO_2 determined by Weller's colorimetric method (*Ber. Deutsch. Chem. Ges.* XV. 1882, p. 2592).

(B) The insoluble fluorides were decomposed by sulphuric acid, and the resulting sulphates brought into solution in cold water. In this solution hydrogen peroxide failed to produce any coloration, thus showing the absence of TiO_2. On boiling, however, a precipitate (ThO_2) was deposited. This was filtered hot, washed, dried and weighed. Its weight was ·0294 grm., corresponding to 6·2 p.c. In the filtrate the Ce_2O_3, &c. was

[1] Lawrence Smith, *Original Researches in Mineralogy and Chemistry*, p. 352.

separated from CaO by a double precipitation with ammonia. On testing the moist ammonia precipitate with dilute hydrofluoric acid, a large proportion was found to be soluble (some ZrO_2 had been retained in the insoluble fluorides). The hydrofluoric acid was expelled by sulphuric acid, and the solution reprecipitated by ammonia. This precipitate was washed, dried and weighed. It was then, together with the ThO_2 precipitate, again brought into solution by fusion with acid sulphate of potassium. From this solution a precipitate was obtained by means of sodium thiosulphate, which on ignition weighed ·0646 grm., corresponding to 13·70 p.c. In the filtrate the cerium and uranium were precipitated by ammonia; this precipitate was redissolved and the cerium separated by precipitation with oxalic acid. The filtrate was evaporated to dryness and ammonia salts expelled before precipitating the uranium. A small portion of this precipitate gave with microcosmic salt a good uranium bead. The oxalic acid precipitate (Ce_2O_3) was ignited and weighed. It was again brought into solution, and the Ce_2O_3 precipitated by potassium sulphate. In the filtrate, oxalic acid gave a slight precipitate, which, on ignition, yielded an oxide (Y_2O_3?), only faintly yellow, and thus distinct from the reddish-buff oxide (CeO_2) obtained from the potassium sulphate precipitate.

The sodium thiosulphate precipitate was found to consist of almost equal parts of ThO_2 and ZrO_2. After ignition and weighing, it was brought into solution by means of hydrofluoric and sulphuric acids. The solution was divided into two equal parts, and each treated separately. In one part the sulphuric acid was neutralised by potash, and the ZrO_2 and ThO_2 thrown down by boiling with potassium sulphate. From this precipitate hydrochloric acid separated the ThO_2, leaving most of the ZrO_2 undissolved. The hydrochloric acid solution was evaporated to dryness. The residue gave a clear solution with cold water, from which the ThO_2 was precipitated by oxalic acid added in considerable excess. The other half of the solution of the thiosulphate precipitate was treated with ammonia until a permanent precipitate formed; oxalic acid in excess was then added. A clear solution resulted, but on adding hydrochloric acid most of the ThO_2 was precipitated. The filtrate from the precipitate was evaporated to dryness, and the ammonia salts expelled. The residue was dissolved in hydrochloric acid, the excess of acid expelled, and the remainder of the ThO_2 precipitated by excess of oxalic acid. The ZrO_2 in the filtrate was precipitated with ammonia. The combined ThO_2 precipitates, after ignition and weighing (·0313 grm.), were dissolved in sulphuric and hydrofluoric acids, the solution evapo-

rated to dryness, and the excess of sulphuric acid expelled: the residue was dissolved in cold water, and the ThO_2 again precipitated with excess of oxalic acid. The resulting oxide weighed 0·0299 grm., and gave a sulphate weighing 0·0492 grm., corresponding to a molecular weight of about 250.

The "Satin Spar" of Alston in Cumberland; and the Determination of massive and fibrous Calcites and Aragonites.

By L. J. Spencer, M.A., F.G.S.,
Assistant in the Mineral Department of the British Museum.

[Read February 4th, 1896.]

OWING to the fact that aragonite frequently occurs in fibrous aggregations, as in "flos ferri," it seems to have been sometimes assumed that all fibrous specimens of calcium carbonate are aragonite.

On these grounds the "satin spar" from Alston Moor in Cumberland is often referred to aragonite, although it has more than once been shown to be really calcite. Miller[1] refers to it under aragonite, as being from "Dufton in Cumberland,"[2] saying that it contains 4·25 per cent. of manganese carbonate: these figures are those given by J. Holme[3] in a very crude analysis of the satin spar of Alston. This error is copied from Miller into Greg and Lettsom's *British Mineralogy* and into Dana's *System of Mineralogy*. The mineral in question seems to have been first definitely determined by A. Aikin, who published an account of it in 1802 in the Proceedings of the British Mineralogical Society.[4] Here an analysis is given, and the density determined as 2·709—2·721, the mineral being placed amongst other varieties of calcite. J. Holme in his analysis[5] found no water, which he supposed to be essential to aragonite. G. Rose,[6] from his determination of the hardness and specific gravity (2·720; in powder 2·724), points out that the mineral is calcite, and not

[1] *Min.* p. 569.

[2] Dufton is in Westmoreland.

[3] *Trans. Linnæan Soc.* XI. 164, 1815.

[4] Tilloch's *Phil. Mag.* XII. 364, 1802. The British Mineralogical Society, referred to above, was started in 1799; references to it are to be found in the *Phil. Mag.* VI. 369, 1800; IX. 282, 1801; XII. 284, 1802; XIV. 289, 1802; XIX. 85, 1804. The objects of the society were especially connected with the mineralogy of the British Isles. The society seems to have fallen through shortly before the foundation of the Geological Society in 1807, and in the first list of the latter society are to be seen the names of many of the 25 members, mineralogical papers by whom were published in the Transactions of the Geological Society.

[5] *Loc. cit.*

[6] *Abhandl. Akad. Berlin*, pp. 7, 11, 1856.

aragonite. The Comte de Bournon, in his *Traité de la Chaux Carbonatée* (I. 166), also describes it under calcite.

The Alston satin spar occurs in straight, regular veins, two or three inches across, in a black shale of Carboniferous age, containing also veins of decomposing pyrites; the veins are parallel to the lamination of the shale. It is of a snow-white colour, with sometimes a delicate rosy tinge, and has a satiny lustre which is strongly brought out on surfaces parallel to the fibre when highly polished. The mineral consists of an aggregation of long, very fine fibres, quite straight and parallel, and arranged perpendicularly to the sides of the vein; it is quite distinct from the coralloidal aragonite of Dufton in Westmoreland, which also has a more or less satiny lustre, but not nearly so marked as in the Alston mineral.

When a fragment is finely crushed and examined under a $\frac{1}{12}$ inch immersion in oil, long, thin, cleavage rhombs of calcite are seen, the directions of optical extinction bisecting the cleavage angles, and thus being oblique to the length of the fibre. In convergent polarised light the usual eccentric uniaxial interference figure of a calcite cleavage flake is seen. The fibres of the satin spar, therefore, consist of calcite crystals enormously elongated in the direction of one of the edges of the primitive rhombohedron. A thin section cut at about 45° to the length of the fibres did not show any interference figure near the centre of the field, as would be expected; this, however, was due to the overlapping of the very fine fibres, which also for this reason did not show any definite extinction. Des Cloizeaux[1] mentions that the fibres are excessively fine, and not sufficiently transparent to have any marked action on polarised light. A thin section cut perpendicular to the fibres showed small interlocking areas of irregular outline, but longer in one direction than in the direction at right angles; each gave definite extinction, but in various directions for the different areas, giving the whole section, as seen between crossed nicols, the appearance of a mosaic. The specific gravity of the fine powder was roughly determined as 2·70.

In fibrous calcite the direction of optical extinction is usually parallel to the length of the fibre, showing that we are here dealing with crystals elongated in the direction of the trigonal axis. The direction of elongation parallel to one of the edges of the primitive rhombohedron seems to be rather unusual for calcite; but an approach to it is sometimes seen in

[1] *Manuel de Min.* II, p. 118.

the isolated crystals of "Iceland spar" from Iceland, which show $r(100)$ with narrow $v(20\bar{1})$ and $w(410)$, and have sometimes a length three or four times the breadth and seven or eight times the thickness, as measured along the rhombohedron edges. Calcite of the same habit as the Alston satin spar, that is occurring in veins, and consisting of straight parallel fibres elongated parallel to a rhombohedron edge, has been noticed in specimens from Andrarum, Skåne, Sweden, and from Neutitschein, Moravia; the former occurs in a black alum-shale with veins of pyrites, and is strikingly similar to the Alston occurrence; the latter occurs in serpentine; the fibres of both are, however, too coarse to show any marked satiny lustre.

As before mentioned, polished surfaces of the larger, massive pieces of coralloidal aragonite from Dufton, Westmoreland, show a satiny lustre, which however is not nearly so marked as in the Alston calcite; also on the smaller branches are often numerous very fine crystals, regularly arranged at a small angle to the surface, these giving a fine satiny lustre to the surface of the branches. The name "satin spar" may, therefore, be applied to both calcite and aragonite, as well as to selenite.

In the examination of these fibrous and massive minerals, with the object of distinguishing and separating calcite and aragonite, the specific gravity and the microscopical characters of crushed fragments were most relied on. G. Rose[1] has shown that the specific gravity of a piece of fibrous aragonite taken as a whole may approach that of calcite; it is therefore necessary to take the specific gravity of the fine powder,[2] or of very small fragments, those having the most compact and homogeneous appearance being selected. If such a small fragment is placed with calcite (sp. gr. 2·72) and aragonite (sp. gr. 2·93) indices in methylene iodide, its specific gravity can be approximately judged by taking the times it floats after calcite and before aragonite, whilst the liquid increases in density owing to the evaporation of the benzene with which it is mixed. Fragments which have a specific gravity appreciably greater than that of calcite may then be considered to be aragonite, as the specific gravity of calcite could only be increased by impurities, which would be easily detected either under the microscope or by the action of acids. The same fragment that had been used for the specific gravity determination was

[1] *Abhandl. Akad. Berlin*, p. 10, 1856.

[2] This was done by H. C. Sorby (*Quart. Journ. Geol. Soc.*, XXXV. proc. 56, 1879), and was the test he mainly relied upon in distinguishing calcite and aragonite in shells, corals, &c.

then finely crushed, and examined under a $\frac{1}{12}$ inch immersion in oil. If the mineral be calcite it is in nearly all cases easy to find small pieces showing the calcite cleavages, with the direction of extinction bisecting the cleavage angle, and in convergent light showing a uniaxial interference figure, usually towards the edge of the field of view. Aragonite, on the other hand, shows no cleavages, and indeed nothing very characteristic, unless a fragment be found which shows the biaxial interference figure near the centre of the field. The difference in the strength of double refraction of the two minerals does not seem to be great enough to be used as a characteristic test, as the fragments under examination are of such variable thickness; bright interference colours are, however, often seen in aragonite, but rarely in calcite.

By these methods it has been shown that many specimens labelled as massive and fibrous aragonite were really calcite. Amongst these were various *onyx* and *stalagmitic marbles;* thus confirming the recent work of G. P. Merrill,[1] who has shown by specific gravity determinations that the onyx marbles consist in nearly all cases of calcite. The *pisolite* of Carlsbad, Bohemia, as is well known, consists of aragonite; sometimes, however, the outer shell consists of radially fibrous calcite, which has all the appearance of having been produced by the paramorphic alteration of the aragonite; and as this shell increases in thickness, the whole spherule may become altered into calcite. The occurrence of calcite with aragonite in the banded sprudelstein of Carlsbad has been described by G. Rose;[2] he, however, considered the calcite to be original.

---

[1] *Smithsonian Report* (*U. S. National Museum*) for 1893-4, 539, 1895. See this vol. p. 165.

[2] *Loc. cit.* p. 57.

Zinckenite and Wolfsbergite (Chalcostibite) from Wolfsberg in the Harz; and the Zinckenite Group.

By L. J. Spencer, M.A., F.G.S.,
Assistant in the Mineral Department of the British Museum.

(Read November 17th, 1896.)

ALTHOUGH zinckenite and wolfsbergite are to be considered as isomorphous, it seems to be as rare a thing to find simple crystals of zinckenite as it is to find twinned crystals of wolfsbergite. In the following note simple and twinned crystals of the two minerals respectively are described.

For wolfsbergite twinning has not been previously recorded; and simple crystals of zinckenite have only been described by Kenngott,[1] although it is possible that much of the finely acicular zinckenite of various localities really consists of simple crystals, but, being unsuitable for measurement, cannot be definitely asserted to be such. The channelled hexagonal prisms of the Wolfsberg zinckenite were interpreted by G. Rose[2] as consisting of three interpenetrating crystals, as in aragonite; he gives a hypothetical figure of a simple crystal consisting of a rhombic prism, with an angle of 59°21′, and a macrodome. The crystals measured by Kenngott were acicular, and, adopting Rose's position, he gives the forms present as ∞O and $\infty O\breve{\infty}$, and the prism angle as 59°26′; he also mentions a large untwinned crystal with a single terminal face.

The specimen of wolfsbergite, on which a twin crystal has been noticed, shows several simple crystals, one of these measuring $3\frac{1}{2} \times 2\frac{1}{2} \times \frac{1}{2}$ cm. The twin crystal consists of two tabular individuals with the trace of their plane of junction parallel to the striations on the basal plane; the twin plane, which is also the plane of combination, is therefore a macrodome. On the broken end of the twin no discontinuity between the two individuals could be detected, so that it is not a case of accidental

[1] *Ber. Akad. Wien*, IX. 527, 1852.
[2] *Pogg. Ann.* VII. 91, 1826.

juxtaposition. The angle between the normals to the two basal planes, as measured from wax impressions, is about 62°; for the twin plane to be (102)[1] the calculated angle is 62°37′.

The zinckenite specimen to be described had, on account of the habit of the crystals, been labelled as wolfsbergite, but analysis showed it to contain lead, antimony and sulphur, while copper and arsenic were absent. The blade-shaped crystals, which are small and somewhat indistinct, form a confused cellular aggregate on the flat surface of a matrix of stibnite and an indistinctly fibrous mineral containing lead, antimony and sulphur; this in turn rests on quartz, on the opposite surface of which are matted fibres closely resembling the feather-ore variety of jamesonite. On the first-mentioned surface are also a few small radiated groups of acicular crystals very like the usual zinckenite of Wolfsberg in appearance. The blade-shaped crystals are deeply striated parallel to their length, and show a large plane (c) with narrow planes (ϵ) at the edges; terminations are usually absent, being seen on only one crystal as a bright rounding. Attempts were made to measure six crystals, but, as they gave an almost continuous band of images, the results are not very satisfactory. On one crystal the four angles $c\epsilon$ were determined as 30°, 31°, 29° and 30°. Another crystal gave $\epsilon\epsilon'$ as 57°, and others, for the same angle, various values between 55½° and 57½°. The mean value of $\epsilon\epsilon'$ may then be given as about 58°, which approaches to Rose's value of 59° 21′. On the second crystal a narrow plane at 90° from c was observed; and in some cases there seemed to be an imperfect cleavage parallel to this plane (*i.e.* a (100)). Placing the crystals in the position adopted by Dana[2] the forms present are then:—

$$c\ \{001\},\ a\ \{100\}^{3},\ \epsilon\ \{102\}$$

The first is new to zinckenite. To this short list of forms are to be added Rose's k {061}, and Luedecke's[4] b {010}.

The qualitative chemical composition, the angle of about 58°, and the absence of any distinct cleavage, make it probable that the above-described crystals are zinckenite, although it is not a matter of absolute certainty. There are several sulph-antimonites of lead, but unfortunately the

---

[1] The position of the crystals is that of Groth, *Tab. Uebers. Min.*, 3rd. Ed. 1889, p. 28.

[2] *System of Mineralogy*, 6th Ed. 1892, p. 112.

[3] This form a {100} has been recorded by Kenngott (*loc. cit.*), but has been previously overlooked.

[4] *Die Minerale des Harzes*, Berlin, 1896, p. 123.

characters of some are imperfectly known; plagionite, meneghinite and geocronite have angles of 59°30′, 55°45′ and 60°16′ respectively, but possess cleavages, and in the case of plagionite the habit is totally distinct.

The only species that have been recorded from the Harz[1] are zinckenite, plagionite, jamesonite and boulangerite, all of which occur with wolfsbergite in the antimony mine, Jost-Christians-Zeche, near Wolfsberg.

The habit of these crystals of zinckenite being so similar to that of wolfsbergite, it would naturally follow that, in order to show the isomorphism between the two minerals, the crystals should be placed in similar positions, as has been done above; in which case they are flattened parallel to the basal plane, and elongated and striated parallel to the macro-axis. The new twin plane of wolfsbergite is then also the same as that given by Rose for zinckenite, namely ε (102). Beyond the usual presence or absence of twinning, the only important difference between the two minerals is the absence of any distinct cleavage in zinckenite. The somewhat abnormal form k {061} present on zinckenite is now seen to be also present on emplectite and wolfsbergite (guejarite)[2].

This position of the crystals has been adopted by Dana for zinckenite, sartorite and emplectite, and by Groth for sartorite, emplectite and wolfsbergite. In fact, for the purpose of showing the isomorphism of the group, the direction of elongation and striation of the zinckenite crystals has been made the macro-axis, the brachy-axis and the vertical axis by Dana, Goldschmidt[3] and Groth respectively; and a similar confusion has existed in the case of wolfsbergite. This has been due to the crystallography of these minerals being imperfectly known, and to the similarity of the angles in all three axial zones, as is shown in the following table of calculated angles—

	Zinckenite $PbS.\ Sb_2S_8$ (Rose).	Sartorite $PbS.\ As_2S_3$ (vom Rath)	Emplectite $Cu_2S.\ Bi_2S_3$ (Weisbach)	Wolfsbergite $Cu_2S.\ Sb_2S_3$ (Friedel for Guejarite)
001 : 102	29° 40⅓′	29° 51¼′	*29° 56½′*	31° 18¼′
001 : 101	*48 44*	48 57	*49 2½*	50 34½
001 : 011	*32 26*	31 45	*32 2*	32 31½
001 : 021	*51 48*	51 3½	51 22	51 54
001 : 061	75 18	*74 55½*	75 5	75 21
100 : 110	*29 8*	*28 19*	*28 30*	*27 40*

[1] O. Luedecke, *loc. cit.*; E. Schulze, *Lithia Hercynica*, Leipzig, 1895.

[2] The probable identity of wolfsbergite and guejarite was pointed out in a paper read before this Society on April 14th, 1896 (see this volume, p. x.).

[3] *Index der Krystallformen der Mineralien*, 1891, III. p. 331.

The above angles are given in italics when the corresponding forms in the second column have not been observed on the particular mineral; (102) is the twin plane for wolfsbergite, but not an observed crystal face. The corresponding parameters are :—

	a		*b*		*c*
Zinckenite	0·5575	:	1	:	0·6353
Sartorite	0·5389	:	1	:	0·6188
Emplectite[1]	0·5430	:	1	:	0·6256
Wolfsbergite[2]	0·5242	:	1	:	0·6376

[1] Groth (*Tab. Uebers. Min.*, 3rd Edit.) calculates from Weisbach's measurements $a : b : c = 0{\cdot}5385 : 1 : 0{\cdot}6204$. The above are as given by Dana (*Min.*, 6th Edit.).

[2] Laspeyres gives for wolfsbergite—$a : b : c = 0{\cdot}52830 : 1 : 0{\cdot}62339$ (*Zeits. f. Kryst.* XIX. 428, 1891).

The Crystallography of Plagionite: New Crystal Forms on Stephanite, Enargite and Anglesite.

By L. J. Spencer, M.A., F.G.S.,

Assistant in the Mineral Department of the British Museum.

[Read November 17th, 1896.]

Plagionite.

ON the British Museum specimens of plagionite from Wolfsberg, in the Harz, all the well-established crystal forms previously recorded have been detected; these are:—[1]

c {001}	a {100}	p {114}	e {112}	n {111}
x {221}	y {331}	s {$\bar{1}$12}	d {041}	

The doubtful forms i\{776\}, z\{$\bar{7}$.7.16\} and δ\{0.10.3\} of Luedecke[2] have not been confirmed. In addition to the above, the following new forms have been observed on the Wolfsberg crystals:—

b\{010\}[3]. A very small, bright plane on the edge between (221) and ($\bar{2}2\bar{1}$).

f\{$\bar{1}$01\}. A small bright plane, observed on two crystals.

g\{$\bar{2}$01\}. As a narrow bright plane, and also as a large plane rounded with a; on three crystals.

m\{110\}. Usually as a narrow plane on the edge between the two sets of pyramids; on one crystal with large faces; observed on three crystals.

l\{223\}. As a narrow bright plane, or as striæ; on six crystals.

---

[1] The letters are those used by Miller (*Min.* 1852, p. 196) and by Goldschmidt (*Index der Krystallformen*, II. p. 479): the parametral plane is that of Goldschmidt, this being the direction of cleavage, and also giving rather simpler indices; other authors have taken e to be \{111\}.

[2] *Neues Jahrb. Min.* II. 112, 1883; *cf.* Goldschmidt, *loc. cit.* p. 480.

[3] Sandberger (*Ber. Akad. München*, XXIV. 241, 1894), mentions for crystals from Goldkronach, Bavaria, the form $\infty\breve{P}\infty$; this is, however, probaby a misprint for $\infty\breve{P}\infty$, which is a very common form on plagionite; or, again, d might easily be mistaken for (010) on mere inspection of the crystals.

$h\{\bar{2}23\}$. As a narrow bright plane, or more often as striæ; on one crystal as a large face in the zone $[221, \bar{2}01]$; observed on six crystals.

$t\{\bar{4}45\}$. As a narrow bright plane, or as striæ; on three crystals.

$k\{\bar{1}11\}$. As a narrow bright plane, or as striæ; on three crystals.

Also, doubtful:—

$\{\bar{7}03\}$. As a narrow rounded plane, on one crystal measured to c as 73°54′, calculated 73°43′.

$\{\bar{7}02\}$. As a narrow rounded plane, and as striæ; on two crystals; measured to c as 83°49′, 84¼°; calculated 84°45½′.

$\{\bar{7}01\}$. Due to roundings and striations on a; several measurements between 96°8′ and 96°50′; calculated, $c : (\bar{7}01) = 96°12'$, $c : (\bar{15}.0.2) = 96°57\frac{1}{2}'$.

{4.4.11}. As a narrow bright plane; on two crystals; measured to c as 19°24′, 20°6′; calculated 19°57′ [$c : (225) = 21°36'$].

$\{\bar{1}14\}$. Several bad measurements from striæ at about this position; calculated, $c : (\bar{1}14) = 15°54'$.

$\{\bar{2}25\}$. Only as striæ; measured to c, 24°17′, 24°37′, 24¾°, 25°34′, 26°26½′; on four crystals; calculated 25°18′. This is near to Luedecke's $z\{\bar{7}.7.16\}$ or $\{\bar{4}49\}$.

The measurements establishing the more certain forms are:—

	Observed Mean.	Limits.	No. of Faces.	Calculated (Luedecke).
xb	51° 18′	—	1	51° 26½′
ab	90 0	—	1	90 0
cf	42 8	41° 54′ — 42° 22½′	2	42 26
cg	68 43	68 6 — 69 7	6	68 34½
cm	78 21	77½ — 79 16	6	78 26½
am	47 44	47 39½ — 47 46	3	47 16
cl	32 32	31 51 — 33 37	6	32 3½
ch	40 3	38 0 — 42 46	9	40 6
ct	46 55	46 20 — 47 40	4	46 18
ck	54 43	52 10 — 56 15	5	54 6½

The striated pyramidal zones usually give a continuous band of reflected images. Numerous measurements from the brighter parts of these bands were rejected, although in some cases they led to definite indices, except when there was a repetition of the same angle several times, or when the reflection was seen to be from a definite face and not from striæ. The forms e n x in the zone of negative pyramids occur as definite faces on nearly all the crystals, but the faces in the zone of

positive pyramids are very badly defined; *s*, for example, being rare as a definite face.

As mentioned by Luedecke[1], there is a frequent oscillation between the basal plane and the pyramids, and, as a result of this, the two faces of the form {001} are rarely parallel. This, in connection with the deep striations, renders the measurements very unsatisfactory—so much so that, although 18 crystals were measured, no attempt has been made to improve on the parameters deduced by Luedecke, which are based on only three measured angles. However, the angle for *am* given above may be taken as fairly accurate, as well as the following angle for *ac*; but, owing to the wide variation in *cn*, not much reliance can be placed on this angle.[2]

	L. J. SPENCER.			G. ROSE.	LUEDECKE.	
	Observed.	Limits.	No. of Readings.	Observed.	Observed.	Calculated.
ac	72° 28½′	72° 3′ — 72° 52′	9	72° 28′	72° 4°½′	—
cn	41 18	39 44 — 42 45	31	41 8	41 7	41° 26½′

The only determination which has been made of the specific gravity of plagionite is that made in 1831 by Zincken, who obtained the value 5·4. The following determinations have been made on Wolfsberg crystals, but they can be only considered approximate owing to the difficulty of separating pure material without destroying the rare crystals.

A group of crystals, with a little "tinder ore" attached, weighing 2·6642 grms., gave sp. gr. = 5·57. Crystal fragments and isolated crystals, with a somewhat drusy surface, weighing 0·667 grms., gave sp. gr. = 5·47.

Six isolated crystals, some with a drusy surface, weighing 0·4640 grm., gave sp. gr. = 5·55.

The mean of these determinations, about 5·5, is thus a little higher than that given by Zincken.

The occurrence of plagionite in the stibnite deposits of Arnsberg, Westphalia, has been recorded by Sandberger,[3] and in his note he mentions that the specimens show some needles having the appearance

---

[1] *Loc. cit.*

[2] These angles, $ac = 72°28½'$, $am = 47°44'$, and $cn = 41°18'$, give the parameters $a : b : c = 1·1538 : 1 : 0·8508$.

[3] *Neues Jahrb. Min.* II. 94, 1883. Compare *Ber. Akad. München*, XXIV. 241, 1894, where different symbols for the faces are given.

of federerz ("plumosite"), which he supposes to be Pisani's "heteromorphite." In Pisani's paper,[1] however, there is no mention of needle-shaped crystals,[2] and the mineral he dealt with was without doubt plagionite, as is to be seen from his minute description of the crystals, which are given as being possibly monosymmetric, and are referred to "heteromorphite" as distinct from jamesonite. He distinctly states, however, that the mineral is not plagionite; but this statement was probably influenced by the results of his analyses and by the habit of the crystals. This habit of the crystals, although it is fairly common on the Wolfsberg plagionite, has only been mentioned by Kenngott.[3] Here the pyramid $n\{111\}$ is elongated in the direction of the zone axis $[111,1\bar{1}1]$ and c and a are equally developed, or one is developed to the exclusion of the other.[4]

The British Museum specimens from Arnsberg agree completely with Pisani's description, and the curved, indistinct crystals were found on measurement to be plagionite. One of the three crystals measured showed the forms *c a p e n*.

According to the analysis given by Pisani, however, the composition ($7PbS.4Sb_2S_3$) of the material is much nearer to jamesonite ($2PbS.Sb_2S_3$) than to plagionite ($5PbS.4Sb_2S_3$). It would have been interesting to have had the details of the four analyses (of which the one given is the mean of three) which were made on the crystalline and massive mineral, especially as the various analyses of the Wolfsberg plagionite show very little variation amongst themselves. For these reasons the Arnsberg mineral has come to be mentioned in the text-books under both jamesonite and plagionite. It is to be noted, however, that it is correctly given as plagionite by Kaiser;[5] and in Groth's General-Register to *Zeits. für Kryst.*, Vols. 1—10, the reference here being to the abstract of Pisani's paper.

---

[1] *Comptes Rendus*, LXXXIII. 747, 1876.

[2] The abstract of Pisani's paper in the *Neues Jahrb. Min.* 300, 1877, mentions needle-shaped crystals, and it is probably hence that the mistake arose. Koort (*Beitr. z. Kenntn. des Antimonglanzes, Inaug.-Diss.*, Berlin (Freiberg i. B.), 1884, p. 10), mentions acicular and capillary stibnite from this locality.

[3] *Ber. Akad. Wien*, XV. 236, 1855: figs. 5 and 6, plate I.

[4] The figure of a plagionite crystal given in Dana's *Mineralogy*, editions 2 to 5, more or less illustrates this case.

[5] *Zeits. für Kryst.* XXVII. 50, 1896, footnote 2.

Stephanite.

To the new forms determined by Prof. Miers[1] on the British Museum specimens the following may be added.

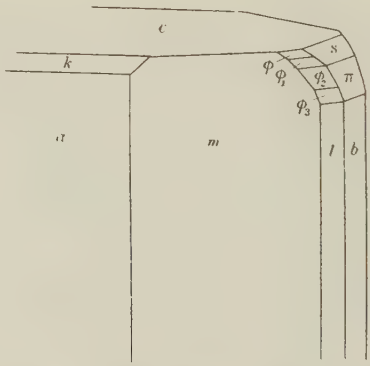
A small bright crystal of stephanite from Chili showed the new forms {551} and {10.10.13} as narrow faces in the zone [001, 110].

	Measured.	Calculated.
c : (551)	81° 23′	81° 10′
c : (10.10.13)	44 36	44 42

The crystal was twinned on $\pi(130)$, and showed twin lamellæ parallel to $m(110)$; the other forms[2] present were $c\,M\,h\,l\,P\,p_2\,r_1\,m\,k\,d\,b$.

Enargite.[3]

A well-developed, isolated, but singly-terminated, prismatic crystal of enargite from Peru (probably Morococha), with large $a\,m\,c$, narrow $b\,l\,h\,d\,k$, and small s, showed the new forms $\pi\{031\}$, $\phi\{132\}$, $\phi_1\{394\}$, $\phi_2\{131\}$ and



$\phi_3\{392\}$. The two quoins of the crystal formed by the basal plane and the prism m (namely by (001) (110) ($\bar{1}10$) and (001) ($1\bar{1}0$) ($\bar{1}\bar{1}0$)) are rounded by these small, rather rough and curved, but bright faces, which lie in the zones $[cb]$ and $[cl]$. The position of $\pi\{031\}$ is fixed by—

		Measured.	Calculated.
$c\pi$	(001) : (031) ..	$68\frac{1}{4}°$	68° $8\frac{1}{3}'$

---

[1] *Zeits. für Kryst.* XVIII. 68, 1891.

[2] The letters for the forms are those used by Dana (*System of Mineralogy*, 6th Ed.); and the above angles are calculated from the parameters he gives.

[3] *cf. Min. Mag.* XI. 69, 1895.

The other faces were then determined by the zones $[m\phi_3\pi\phi_1']$, $[m\phi_2\phi']$, $[m\phi s\kappa']$ and $[a\phi_2 s]$, and confirmed by the angular measurements, which, however, in some cases depended on maximum illumination. Another similar crystal, from the same locality, showed the forms *c k μ u a r m l b o*, together with indefinite rounded planes in the zone $[cl]$.

Anglesite.

A specimen, of unknown locality, recently presented to the Museum by Mr. H. J. Gardiner, F.G.S., shows numerous well-developed crystals of anglesite on a matrix of pyrites, the latter being coated with a thin green layer of sulphate of iron. The crystals are of prismatic habit (in the direction of the zone axis [100]), and are terminated, often at both ends, by an acute pyramid; the only forms present being $o\{011\}$ and the new form $l^1\{255\}$. The faces are striated parallel to the intersections of the dome and the pyramid; the domal faces are much smoother and brighter than the pyramidal faces. The following measurements were obtained from one crystal:—

		Measured.	Calculated (Kokscharov).
$011 : 0\bar{1}1$	...	104° 18′	104° 24½′
$011 : 255$	...	21 51 21 57 22 0	21 55⅔

An occurrence of Prehnite in Wales.

By W. Jerome Harrison, Junr.

[Read November 17th, 1898.]

THE little land-locked harbour of Pwllheli in Caernarvonshire owes its existence to a boss of igneous rock, which forms a natural breakwater, and which is known in Wales as the "Gimlet Rock."

The large quarries afford excellent exposures of the rock, which is worked into "setts" and used largely for paving purposes in the large towns of Lancashire, etc. It is a coarse ophitic dolerite, in which the augite is a very conspicuous mineral. The rock is traversed by many segregation veins, and is much jointed. The faces of the larger joint-planes are covered with crystals of quartz, calcite, a little natrolite, brookite and prehnite. But the three last-named minerals are of rare occurrence, and are always associated with quartz.

The *prehnite* crystals I found at the "Gimlet" last July.

On the Micas of the Three Rock Mountain, Co. Dublin.

By Professor J. P. O'Reilly, Roy. Coll. of Science, Dublin.

[Read April 14th, 1896.]

THE micas presented by the granites of the Co. Dublin have been analysed by Haughton, and determined by him to be margarodites and lepidomelanes (see *Proc. Roy. Irish Ac.* Vol. VI. 1855, pp. 176-79, and *Quart. Journ. Geol. Soc.* Vol. XV. 1859, p. 129). In this latter paper he says:—"In my first paper on the Granites of Leinster (*Quart. Journ. Geol. Soc.* Vol. XII. 1856, p. 171), I have mentioned the black mica which is found accompanying the white margarodite of the Leinster granite in small flakes, and noticed the curious fact that these flakes are sometimes physically embedded in the plates of white mica without injuring their fissility or lustre, but always effecting a reduction of about 20° in the angle between the optic axes of the latter."

In the first mentioned paper ("On the Chemical Composition and Optical Properties of the Mica of the Dublin, Wicklow and Carlow Granites") he thus describes the first specimen examined:—"No. 1. Mica from the Three Rock Mountain, Co. Dublin; gray, transparent, containing specks or flakes of a bronze-coloured or black mica."

He further adds, when speaking of the deviation of this mica from the formula found to result from his analysis:—"The mica which deviates the most from this formula is the mica of the Three Rock Mountain, and this deviation may possibly be due to the presence of grains of black mica, which also occurs in the mass of the granite, and of which I was unable to obtain a sufficient quantity for chemical or optical examination; the quantity of protoxides in the Three Rock Mica is somewhat in excess of that required by the formula."

The author of the present paper having frequently had occasion to pass by the road which leads over the east end of the Three Rock Mountain into Glencullen, had his attention drawn to the micas which show themselves in the stones and boulders forming the walls and fences of the fields along the road. These micas are relatively large, very pearly in lustre, and almost without exception, when large, show a zonal

structure due to the linear arrangement of the bronze and brown specks or flakes, and very generally the central part of the mica is filled with these same flakes or patches, but with larger dimensions. Struck by this character, and desirous of examining the relations of the constituent parts, I collected from time to time a large number of these micas from the stones and boulders, and also from a portion of a mica band or vein which occurs on the north side of the mountain, in the midst of the stone quarries which extend over this face.

I proposed to mechanically separate the white or colourless portion of the micas from the bronze or black specks, and to have each part thus separated chemically examined. The task of separation was undertaken by Miss Mary Robertson, M.A., then engaged in research work in the laboratory of the Royal College of Science, under the direction of Professor Hartley; and after some weeks of tedious and careful picking, enough of the separated materials was obtained to allow of the proposed analysis being undertaken. The following is the Report which she furnished as to the result:—

"Chemical Laboratory,

"Roy. Coll. of Sci., Dublin, May 4th, 1889

"Sir,—With regard to the sample of mica submitted to me for analysis, I have made the following observations. The mica is essentially white or colourless, but contains black specks, generally occurring in the centre of the crystal, *i.e.* in hexagonal shape, and leaving the centre comparatively clear. In cleaving the mica, black stains were often visible, coinciding in shape with a speck underneath, The specks usually broke away with comparative ease from the surrounding white portion. One black portion was found of rather larger size than usual, which had the hexagonal shape of the large crystals.

"In preparing for the analysis, the crystals were split, and the black specks separated and collected under the microscope. The white portion was also carefully collected, and freed from any black specks. Separate analyses were made of the two substances so obtained.

"The quantities available were so very small that only a quantitative analysis could be made; but in the course of this analysis search was made for substances which might occur.

"I find that the white portion contains as follows:—

Weight taken for analysis—for bases	...	1·1056 grm.
,, ,, ,, ,, for alkalies	...	0·6075 ,,
Loss by ignition ...	...	4·710 per cent.
SiO_2	...	39·414 ,,
(Cuprous Oxide) Cu_2O	...	3·654 ,,
Al_2O_3	..	33·738 ,,
Fe_2O_3	...	1·418 ,,
MnO	...	1·244 ,,
MgO	...	1·344 ,,
CaO	..	0·955 ,,
Li_2O	...	0·642 ,,
Na_2O	...	2·675 ,,
K_2O	..	9·430 ,,
Total	...	99·224 ,,

"An analysis of the black mica was also made, but copper and iron seemed to be present in varying quantities, so that different portions gave varying results.

"It was then found that on treating the dark specks with hydrochloric acid, the colouring matter dissolved, leaving a residue of white mica. A portion so treated gave on analysis:—

Residue insoluble in HCl		45·14 per cent.
Ferric Oxide, containing traces of Mn	...	45·14 ,,
Cuprous Oxide	...	9·78 ,,
(The amount taken for analysis having been 0·0101 grm.)	...	100·06 ,,

"The copper was very carefully estimated in another portion of the dark substance, and found to amount to 22·5 per cent. Cu_2O; the alkalies in the same portion were 13·70 per cent., estimated as soda.

"The iron was estimated in another portion of the dark substance, and found to amount to 25·35 per cent. of Fe_2O_3. Hence the copper and iron appear to occur in varying proportions in the dark substance.

"A portion of the loss by ignition is due to *hydrofluoric acid*, traces of which were found; none was observed in the substance after ignition, though carefully tested for.

"A portion of the original substance, containing both the white and the black bodies, was used to estimate the combined water, and gave the following result:—

Water driven off at 100°C.	0·2506	per cent.
,, ,, ,, between 100° and 240° ...	0·1058	,,
Thus showing that the loss on heating to 240°C. was	0·3564	,,

"(Signed) MARY W. ROBERTSON, M.A."

Comparing this analysis with that of Dr. Haughton already referred to (given in *R. Irish Ac. Proc.* Vol. VI. 1855, p. 177), and which is mentioned as "No. 1, Mica from the Three Rock Mountain, Co. Dublin; gray transparent, containing specks or flakes of a bronze coloured or black mica," the following differences appear—

	Miss Robertson's.	Dr. Haughton's.
SiO_2 ...	39·414 per cent.	43·47 per cent.
Al_2O_3 ...	33·738 ...	31·42
Fe_2O_3 ...	1·418 ...	4·79
CaO ...	0·955 ...	1·38
MnO ...	1·244 ..	——
MgO ...	1·344 ...	1·13
K_2O ...	9·430 ...	10·71
Na_2O ...	2·675 ...	1·44
Li_2O ...	0·642 ...	——
Cu_2O ...	3·654 ...	——
Loss by ignition	4·710 ...	5·43
	99·224	99·77

It may be remarked that the amount of SiO_2 in the analysis of Miss Robertson is lower by 4·056 per cent. than that of Haughton, and lower than any example of muscovite cited by Dana in the edition of 1892, p. 617, wherein the extreme values for SiO_2 are 49·34 per cent. and 43·67 per cent. Assuming Miss Robertson's determination of the silica to be quite correct, the amount found, 39·414, would correspond rather with a biotite, and in this respect would harmonise with Haughton's remark as to the reduction of the angle of the axes. The other values correspond fairly well; what however is remarkable is the high value for the

cuprous oxide, Cu_2O = 3·654 per cent. The element copper is not unknown, as a constituent of the micas, since in the list given by Dana it occurs in two cases, one amongst the analyses of damourites, &c., and the other in the analysis No. 61 of "*Œllacherite*" from the Pfitsch-thal with an amount of CuO = 0·31. In both cases the copper is given as cupric oxide. However, there is evidence that it may occur in relatively large quantities in certain minerals of the chloritic group, as is shown by Sterry Hunt, in his *Mineral Physiology*, 1886, p. 357, where he describes, under the name of "Venerite," a mineral containing, according to the analysis of Hawes, 17·58 per cent. of CuO, and referred to the chlorites.

Assuming for the moment that the copper found in the Three Rock Mountain mica by Miss Robertson exists in combination with SiO_2, it is presumable that such a silicate of copper should to some extent influence the colour of the white mica, since no colourless silicate of copper so far is known. Now the samples analysed by Haughton as well as the material used by Miss Robertson seem to have been equally devoid of colour (macroscopically examined), and are described as being *gray and transparent*.

Under the microscope, however, most of these transparent gray and colourless muscovites of the locality mentioned show black specks, more or less minute, and for the most part round like blots of ink, or exceptionally somewhat hexagonal.

These minute specks may be tenorite (CuO), and the fact that, according to Jenzsch, the artificially prepared tenorite is rhombic and possesses a perfect basal cleavage would favour the presumption. They might equally be *melaconite*, which also presents itself in a scaly form, and occurs interlaminated with chlorite. The *melaconite* of Vesuvius is stated by Dana to be frequently hexagonal, and sometimes triangular in shape. The different forms presented by the black specks would best agree with this interpretation, and with other characteristics of the muscovites now considered.

It must be remembered that the specimens examined by Miss Robertson were from different points of the mountain, and that some particular point, say the mica vein mentioned, may really have furnished the copper samples.

The muscovites of the Three Rock Mountain and vicinity present other characteristics which connect themselves with those already considered, and come out when thin cleavage plates are examined under the microscope. For the most part the plates show a zonal structure, the zones being mainly composed of irregularly bounded brown patches, sometimes showing

a rough hexagonal form with rounded corners and only rarely clearly defined hexagonal or triangular forms: these patches are evidently very thin and intermixed with the plates of muscovite, but so that the patches cover one the other quite irregularly as regards outline, giving rise thus to composite patches of quite jagged contour. With these brown patches and lying between them occur black specks and spots smaller in extent, evidently connected with the brown ones, generally round, sometimes fringed with a less black or very dark gray mineral; lastly, here and there in the majority of plates examined from the Three Rocks Mountain, but sparingly and quite microscopically appear what may be designated "blue micas" (?), which contrast markedly with the brown and black spots by the perfect geometrical regularity of their forms.

The largest individual specimen examined did not exceed 0·5 mm. in breadth, and generally they are quite microscopic but very distinct (see Pl. iv.). The predominant forms are seemingly perfect equilateral triangles, hexagons resulting from the truncation of the angles of such triangles, perfect hexagons and occasionally forms of rectangular shape or of an L shape pointing to the existence of rhombic cleavages in the mineral. Their colour presents all the shades of blue from faintly purple to most intense blue, such as Prussian blue or the cobalt blues of pottery ware; exceptionally a faint but distinct rose tint is met with, and more frequently the blue is so intense as to appear black. The contours are always strictly geometrical, and the angles formed by the sides perfectly sharp and well defined. The plates are evidently very thin, and may be seen, even in thinly cleaved micas, covering one another; they are translucent, and under polarised light they behave isotropically.

Apart from the colour, their form and their conditions of relation to the containing mica would favour the opinion of their being micas, but the colour, or rather colours, presented by them would lead to their being referred to one or other of the minerals characterised by blue colours. As regards the black triangular plates, there is every reason for connecting them with the black spots or patches already referred to, and consequently considering them as melaconite; on the other hand, it is reasonable to see in the blue triangular plates always present with the black ones a variety or an altered form of the same mineral, such as for instance a chrysocolla ($CuO.\ SiO_2+2aq$) altered from the melaconite or tenorite. This presumption would be in accordance with the translucence and low refrangibility of the plates, the forms and the analysis, but can only be taken as a presumption until further examination of them has fixed their

true nature; as, however, there are other minerals characterised by a blue colour and allied to the micas, it is necessary to examine whether one or other of them may not better correspond to the characters presented by the mineral in question. Dana mentions amongst such minerals Diphanite and Vaalite.

Considering, however, that *iolite* has been determined by Dr. Joly to exist in the granites of the neighbouring valley of Glencullen, distant from the Three Rock Mountain only about 1½ mile (see *Sc. Proc. Roy. Dub. Soc.* 1886, Vol. V. part 2), and that the colour of the plates corresponds well in a number of cases with that of iolite (Berlin blue in different intensities), the question arises Do the other characteristics presented by the plates correspond to those shown by iolite? Certain of the angles of the apparently equilateral triangles were measured, and while one gave 60°, another more carefully handled gave 61°18′. Now this would rather point to a rhombic mineral, having a prism angle approaching 120°, as in the case of iolite, and $\infty P\breve{\infty}$ cleavage as presented by this mineral (see fig. c, Pl. VI.). Lastly, if there be supposed a composition plane parallel to ∞P, the triangular form presented by the mineral becomes intelligible (see fig. g, Pl. VI.), giving for the angle at the summit 60°50′, and for the two basal angles 59°35′. This twinning being assumed, an explanation is afforded of the little *notch* presented so frequently by the plates on one of the sides of the triangle, as shown in one of the figures (fig. a of Pl. VI.). Lastly, the fig. c same plate points to alterations along a section taken as $\infty P\breve{\infty}$, and so far confirms the rhombic character of the mineral. From the co-existence of the different characters it may reasonably be assumed that the mineral in question is "iolite" in a more or less altered state, and then, according to Dana, tending to the "division of the prism into plates parallel to the base." The largest of these plates met with was only 0·5 mm. broad, and is represented on fig. 2, Pl. IV. The notch referred to is here also observable, as also on many of the black triangles and hexagonal forms shown on Pl. IV., and seems to connect them so far with the blue plates.

The brown patches so characteristic of the micas, as indeed of many other muscovites, were studied by G. Rose (see *Monats-ber. der Acad. Berlin*, 1869, p. 339); he noted that generally the white colourless mica surrounds the brown ones. He concluded that the black to brown tablets were ironglance, while Dana and Brush considered the black plates to be magnetic iron, the red ironglance, and the yellow hydrated oxide (see Zirkel, *Elemente d. Mineralogie, von* C. F. Naumann, 1881, p. 571).

The black patches present themselves under two forms, or rather three:

regular triangles or hexagonal forms, perfectly opaque; blebs or blots equally opaque, but irregular in form, and frequently "dusted" or sprinkled, as it were, between the plates of mica; and lastly, round patches, grayish rather than black, the tint graduating in intensity from the centre to the circumference, as indicated on Pl. VII. These are remarkable in that the centre of figure is frequently marked by the presence of a microlite, perfectly transparent and colourless as a rule; seemingly of the same nature as the many similar microlites which show themselves in most of the mica plates examined. What the exact relation may be that seems to exist between the central microlite and the black patch has not been ascertained so far.

In all the micas examined, the presence of the rod-like voids which have been frequently noticed by most observers was recognised and in certain cases they appear filled with a product of decomposition having an earthy appearance of a yellowish colour.

The brown patches generally found in the centre of the mica plate, and having seemingly no relation of arrangement with the sides of the crystal, are frequently surrounded by a zone of smaller brown patches and brownish crystallites, generally forming a line parallel to the sides of the prism, and therefore having a rhombic or hexagonal outline. This zonal structure is markedly present in the micas from the east side of the Three Rock Mountain. Its general character is indicated by the enlarged drawing shown on Plate V., on which is also indicated the remarkable banded structure observable in the mica plate when held in a plane of about 45° with the line of vision, and then examined with a lens. These bands generally lie outside the zone of small brownish patches, and but rarely extend to the margin of the plate. They would seem to be connected with stages of growth of the mica crystal. The small brownish patches already referred to seem at first sight to have no relation of direction with the principal lines of the mica plate; but more carefully examined, they frequently show themselves as lying nearly perpendicular to the direction of the zone, just as crystals lining a cavity of a rock stand out more or less normally from the sides.

Amongst these small brownish patches occur frequently small prismatic crystals, quite regular in form, and presenting angles which would point to rhombic or monoclinic forms. Certain of them are markedly dichroic, and show strong absorption—so much so indeed that sections which are nearly invisible when in one section-plane of the nicol, become nearly black or very intense brown when brought into the other. A certain number of them show reddish-brown in one plane of the nicol and

greenish in the other, tints characteristic of hypersthene, but the absorptions are quite equal to those presented by the hornblende series. No indication, however, of a hornblende cleavage was remarked. These crystals are quite microscopic, but from the sharpness of the outlines the angles are measurable. The colour is generally somewhat redder and the lustre greater than in the case of the brown mica plates, while the refrangibility is evidently great.

While occupied with these micas and continuing to collect from the eastern side of the Three Rock Mountain only, circumstances led me to look for large sized micas on the western side, at the point known as Barnaculla. Here a vein of very micaceous granite was shown me evidently having undergone fissuring and pressure, the mica plates which it shows presenting a certain parallelism of direction and crumpling, the rock possessing a gneissose character. These micas are often two cm. in length and show regular forms, that is, are more or less hexagonal or rhombic in outline. They proved to be somewhat harder than the micas of the east side, cleaving with more resistance and showing on the cleaved faces undulations, seemingly the consequence of pressure. The examination of the cleaved plates of these micas showed differences of constitution, as regards the micas of the east side of the mountain, very interesting, and so general throughout as to be in all probability characteristic of a large extent of rock. One of the peculiarities presented by them is a certain crumpling or fluting along the margin of the cleaved plate, see Pl. V., as if the crystal had been subjected to pressure and strain parallel to the directions of the sides of the crystal. This crumpling extends to a certain distance into the field of the plate, and is associated, as in the case of the micas of the east side, with the zonal line structure already referred to, as also with a similar zonal arrangement of small mica specks or flakes, with however the marked distinction that while in the micas of the east side examined no green patches or flakes showed themselves, they seem to dominate the brown patches in the cleaved plates from Barnaculla and to characterise them very distinctly. These green patches present, on the whole, outlines less jagged than the brown ones of the east side: the forms are often regular, and somewhat hexagonal in shape. The colour is generally that of a green olive oil, drops of which the micas frequently resemble; the lustre is weaker than that of muscovite, and corresponds to that of certain biotites and the generality of chlorites. The figures (*a*) and (*b*) of Pl. vii. give illustrations of their appearance under the microscope. In (*a*) the mineral is penetrated with minute grayish and blackish granules,

while in (*b*) the granules are larger, seemingly of the same nature as the mineral itself, and show stumpy prismatic forms not sufficiently regular in any of the specimens examined to allow of trustworthy measurements being made. With this granular structure is intimately allied the development of reticulated and brush structures, made up of opaque brown lines or needles and intersecting at angles seemingly in relation with the crystal forms of the mica. Every gradation of reticulated structure may be observed, from the merest outline to the complete filling up of the crystal space. Examples are shown on Pls. VI. and VII. Such reticulations are characteristic of rutile, and are well-known occurrences in quartz and also in biotites. When the network shows forms with an angle of about 60°, as occurs in the specimens examined, the structure represents the "sagenite" of Saussure. The examples presented by Pl. VII. (*c*) and (*d*), correspond well with that form; but in nearly every plate of green mica examined, there were present these brown reticulations in more or less advanced stages. They are referred to by Zirkel in his article on biotite, in his last edition of his *Lehrbuch d. Petrographie*, Vol. I. pp. 330-333 (1893). He examines very fully the question as to whether these reticulations are to be considered of primary or of secondary formation, and cites the different authorities for and against. His conclusion is that in reality the apparently contradictory statements of the observers cited may be reconciled by admitting that in biotites rutile may exist as of primary formation. In those of Barnaculla the occurrences are so frequent and general that every degree of development of formation may be observed, and as green micas exist therein which show no rutile needles, it is reasonable to assume that the reticulations are of secondary formation This is to a certain extent borne out by the fact that in certain plates a last stage of decomposition may be seen, whereby the needles seem to become earthy, to lose distinctness of outline, and assume forms markedly dendritic, as shown in Plate vii. Judging from the colour and other characters presented by this last stage of decomposition, it may be assumed that it represents the titanomorphite state.

None of the analyses published of Irish micas show the presence of titanic acid, although in the series given by Dana for muscovite and for biotite TiO_2 is frequently indicated as present; in the case of the muscovites only in small quantities (to 1·52 per cent.), but in that of biotite more frequently and in more notable quantities (up to 4·73 per cent.). In the rocks of Bray Head, however, it has been shown to exist, and a more extended and careful series of analyses would in all probability show its presence in the micas of the Dublin granites, more especially in

the biotites, taking the "sagenite" reticulations herein described as indications of such presence.

Note on the presence of copper in the mica of Glencullen, Co. Wicklow (referred to in Professor O'Reilly's paper "On the Micas of the Three Rock Mountain").

(Extract of letter from Mr. Charles Darling, Assoc.R.C.S. Dublin, Demonstrator in Chemistry at the Royal Military College, Woolwich, 3rd March, 1899.)

"I have much pleasure in forwarding you the figures of my analysis of the Glencullen mica, taken from my college note book:—

SiO_2	...	42·99 per cent.
Cu_2O	...	0·10 ,,
MnO	...	0·06 ,,
FeO	...	2·69 ,,
Al_2O_3	...	34·44 ,,
CaO	...	0·54 ,,
MgO	...	0·77 ,,
K_2O	...	13·27 ,,
Na_2O	...	trace ,,
H_2O	...	5·05 ,,
		99·91 ,,

"The cuprous oxide, as you will observe, is much less in quantity than was found to be the case with the Three Rock Micas. I believe in the latter case the Cu_2O crystals were distinctly visible, and were traced out under the microscope by Miss Robertson. In the sample provided me by Professor Hartley no such operation was possible; but there can be no possible doubt as to the presence of the copper in the proportion stated, as I made the estimation three times with the same result. The quantity being small, a colorimetric method was adopted, the *modus operandi* being as follows:—

"The mica was fused with mixed carbonates of soda and potash until decomposed; then treated with strong HCl and taken to dryness to render the SiO_2 insoluble; treated again with HCl and filtered. The filtrate was then saturated with H_2S, the copper precipitate filtered off, and after washing with H_2S water, was dissolved in boiling dilute HNO_3. Excess of ammonia was now added, so as to produce the blue colour, and the solution transferred to one of two graduated tubes having the same bore.

The second tube contained a solution made by dissolving a known quantity of metallic copper in HNO^3 and adding excess of ammonia. One or the other was then diluted until the tints were matched."

Note on Miss Robertson's Analysis of the Three Rock Mountain Mica. By Professor W. N. HARTLEY, F.R.S., Royal College of Science, Dublin.

[Communicated April 26th, 1897.]

IN the analysis of mica executed by Miss Robertson for Professor O'Reilly in my laboratory, and under my guidance and advice, it will be observed that the copper is stated to be present as cuprous oxide Cu_2O. There was no evidence whatever of its being cupric oxide CuO. That the whole of the copper was present as Cu_2O in the sample analysed was shown by the following tests, which were made by me at the time: —

1. The microscopic examination of the mica showed the presence of no black, green or blue particles, such as would be characteristic of a cupric compound. 2. The colour of the mica, which was reddish, was seen to be caused by crystalline spangles of a bright red colour, many of them more or less of a ruby or garnet tint. 3. These coloured particles dissolved easily in warm hydrochloric acid, leaving the mica clear and colourless. 4. The hydrochloric acid solution was brown, and on dilution with water became turbid from a precipitation of what can only have been white cuprous chloride. 5. The particles of mica which were coloured gave a red glass by fusion with borax. This would not have been the case with a cupric compound.

There being no evidence whatever of the copper being in two different states of oxidation, the analytical results were calculated upon the evidence afforded by the above tests, for which the quantity of material available was very small.

On Nemalite from Afghánistán.

By F. R. Mallet, late Superintendent, Geological Survey of India.

(Read February 2nd, 1897.)

IN 1887, when I was in charge of the Indian Geological Survey laboratory, a specimen of a mineral recently discovered in Afghánistán was sent to Calcutta by the British Agent at Kábul, with a request for information as to its nature and value. It proved to be nemalite, and a quantitative analysis of it, which was subsequently made by Mr. T. Blyth, is published in the fourth part of *A Manual of the Geology of India*, p. 161. As it seemed possible that the mineral might be capable of some useful application if plentiful, and it was in any case of mineralogical interest, a request was made to the Agent for further information about it, including the locality where it was found, and for additional specimens. The information asked for did not appear to be procurable, but a box full of the mineral, containing, as far as I remember, more than half a hundredweight of the substance, was sent to the Geological Museum. When retiring from India some years ago, amongst a few specimens of Indian minerals which, with the permission of the then Director of the Survey, Dr. King, I brought to England, in the hope of being able to examine them at some future time, was a picked sample of the nemalite in question. It is, however, only recently that circumstances have allowed of my making a commencement of such work, by an examination of the mineral I have alluded to.

The specimens sent were all very similar to each other in outward appearance, but differed more or less in the amount of alteration they had undergone, which could be roughly judged by eye through variations in colour and translucency. The sample I selected was one of those which appeared to have undergone the least change.

It consists of a mass of straight, very fine, highly flexible and elastic, easily separable fibres eight inches long, which seem clearly to have formed part of a vein. Some particles of serpentine, adherent to one end of the specimen, indicate that the rock in which brucite has generally

been found elsewhere is the probable matrix in Afghánistán also. The ends of the specimen show that the fibres were not perpendicular to the walls of the vein, as is more usually the case with fibrous minerals, but made an angle with the walls of about 20 (or 160) degrees. Whether this was due to a local twist in the direction of the walls at the spot from which the specimen was taken, or is common to the whole vein, I do not know.[1] Both ends of the specimen show very obvious signs of chemical alteration, but the central part, for about five inches, is, to all outward appearance, both to the naked eye and under the microscope, perfectly fresh; and that it has not undergone any considerable change is shown by the absence of both carbonic acid and ferric oxide. The sample used for examination was of course taken from this portion.

Viewed transversely to the fibres the colour by reflected light is sea-green, with a silky lustre; by transmitted light, pale to dark sea-green, according to the thickness of the specimen. Viewed by transmitted light parallel to the direction of the fibres, the colour is very similar. In a specimen an inch long, the colour is sufficiently intensified to approach a pale emerald-green. The colour of the mineral is doubtless due, mainly at least, to the unusually large amount of ferrous oxide it contains. There is no perceptible dichroism.

A section perpendicular to the direction of the fibres[2] shows no dark cross or rings in convergent polarised light. In parallel light, with crossed nicols, the field is rather brightly illuminated, and rotation of the nicols together does not alter the illumination. A cylinder of the fibres, again, lying parallel to the stage of the microscope, exhibits double refraction, and no alteration in the phenomenon is observable during a rotation of the cylinder on its own axis. The optical elasticity is greater in the direction of the fibres than transverse to them. The above observations are in consonance with the statement of Lévy and Lacroix, that in nemalite "les fibres sont allongées suivant un des côtés de l'hexagone et négatives,"[3] and, with the optically positive character of brucite, nemalite included. But they apparently indicate that the vertical crystallographic axes, *c*, in the different fibres (which are so minute that in a cross section they are individually quite invisible

[1] Dr. Hidden, who was present when this note was read, remarked that the Nemalite of Hoboken, N.J., shows a similar obliquity between the direction of the fibres and that of the walls of the vein.

[2] I am indebted to Professor J. W. Judd, C.B., for kindly having the section cut for me, and also for several references bearing on the subject of brucite.

[3] *Les Minéraux des Roches*, 1888, p. 162.

under the microscope[1]) lie, not in parallelism with each other, but in varying directions in the plane perpendicular to the cross section of the fibres.

The value obtained for the specific gravity, at 60° F., is 2·454; a high result, which must be ascribed to the large amount of iron present.

The mineral (free from hygroscopic moisture) gave on analysis:—

		Oxygen ratio.[2]	
Magnesia	62·00	24·58	26·33 (or 1·003)
Ferrous Oxide ...	7·87	1·75	
Manganous Oxide...	trace		
Water	29·55		26·24 (or 1)
Silica	·38		
	99·80		

A faint trace of lime was detected spectroscopically.

The only point in which the above figures differ noticeably from Mr. Blyth's is in the smaller amount of iron; but the sample used in his analysis was from a different specimen, obtained at a different time, and possibly from a different part of the vein; and more or less variance in the relative proportions of the isomorphous oxides is what might be expected.

The silica is left undissolved by hydrochloric acid, in the form of translucent tangled fibres, which dissolve in a hot solution of sodium carbonate. They are indistinguishable in appearance from the siliceous fibres which remain when chrysotile is decomposed by the same reagent. As nemalite and chrysotile are usually found under similar conditions—in the form of veins traversing serpentine—it seems not unnatural that the two allied magnesian fibrous minerals should co-exist intimately mixed in the same vein, and it appears not improbable that such is the case in the substance under discussion.

If, then, the silica be regarded as a constituent of chrysotile, and to the latter be assigned the theoretical composition of the mineral, with the magnesia and iron in the same proportions relatively to each other as in the nemalite, the above analysis will stand as follows:—

---

[1] With linear magnification of 180.

[2] Mg = 24·36, Fe = 56·00, H = 1·0076

	Chrysotile.	Nemalite.	Calculated to 100.	Oxygen Ratio.	
Magnesia ...	·35	61·65	62·32	24·71	26·47 (or 1·001)
Ferrous oxide ...	·04	7·83	7·92	1·76	
Manganous oxide	—	tr.	tr.		
Water	·11	29·44	29·76		26·43 (or 1)
Silica	·38				
	·88	98·92	100·00		
		99·80			

Granting the existence of the chrysotile, whether it should be regarded as formed synchronously with the nemalite, or as present owing to one mineral having been altered into the other, I do not know. As previously remarked, the substance analysed showed no indication of change unless the presence of silica be regarded as such. On the other hand, a portion of the substance near the end of the specimen, where it was obviously changed, contained 2·26 per cent. of silica fibres, = 5·28 per cent. of chrysotile, or six times as much as the portion fully analysed. But this excess of silica was accompanied by the presence of carbonic acid and ferric oxide, which might, therefore, perhaps be expected to accompany the smaller amount of silica (·38 per cent.) also, if the latter were due to alteration of the nemalite; and the larger percentage of silica may be caused merely by original unequal distribution of chrysotile through the specimen.

Near the ends of the specimen the original green colour is changed to a light hair-brown, the mineral still retaining its translucency, the alteration being due to a very partial peroxidation of the iron. Beyond that, again, the fibres are white, with a pale reddish tinge, and comparatively opaque. This portion (besides the silica mentioned above) contains a considerable quantity of carbonic acid, owing to the nemalite having been more or less fully converted into hydromagnesite; and the ferrous is largely, or entirely, changed to ferric oxide. There is also a certain amount of non-fibrous and scaly, or in part stellate-lamellar, hydromagnesite on the ends of the specimen, which was formed, apparently, by deposition on the nemalite, not by alteration *in situ*. This hydromagnesite encloses some magnetite, which may perhaps be taken as representing part of the ferrous oxide of the nemalite (from some other portion of the vein), from which the deposited hydromagnesite was probably formed.

Note on Altaite from Burma.

By Henry Louis, M.A., A.R.S.M., F.I.C., F.G.S., Professor of Mining in the Durham College of Science, Newcastle-upon-Tyne.

[Read February 2nd, 1897].

BY the kindness of Mr. A. H. Bromly, Manager of the Choukpazat Gold Mining Company's mines at Choukpazat, Wuntho, Upper Burma, I have received a few hand-samples of the veinstuff from these mines. The vein runs in clay slate or chloritic slate, parallel apparently to the bedding, with a strike north-east to south-west, and a dip of 20° to 25° to the south. The veinstuff, to judge from the samples submitted to me, consists of white, somewhat saccharoidal quartz, with some calcspar, and contains iron pyrites, arsenical pyrites, visible free gold (rather pale in colour and apparently rich in silver), and the mineral that forms the subject of the present note. The latter generally occurs together with comparatively coarse gold in the richer portions of the vein, finely crystalline, though no distinct crystals can be made out, and very minutely disseminated, no particle larger than about 0·05 of an inch having been seen by me. The mineral is tin-white, with a somewhat yellowish tinge, has a high metallic lustre, and is quite opaque. It appears to be brittle; the broken particles show very perfect cleavage, which, under the microscope, can (probably with safety) be pronounced to be cubical. The hardness is 2-3. No particles sufficiently large for a determination of its specific gravity could be obtained.

I succeeded in separating 0·375 grain in a state of approximate purity for an analysis. With so small a quantity at my disposal, a high degree of accuracy was of course out of the question. The mineral was completely decomposed by moderately concentrated sulphuric acid, sulphate of lead being formed, whilst tellurium went into solution. The composition found was the following:—

Tellurium	34·2	91·6
Lead	57·4	
Iron	0·2	6·1
Calcic Carbonate	3·8	
Silica	2·1	
	97·7	

Silver was present, but not in determinable quantity.

Calculating the percentage composition upon the two essential elements, the above ratio corresponds to—

Tellurium	37·4
Lead	62·6
	100·0

This composition answers very closely to the formula PbTe, the percentage composition required by which is as follows—

Tellurium	37·9
Lead...	62·1
	100·0

The correspondence thus shown is sufficiently close to enable me to identify the mineral as the altaite of Dana, although it appears to differ from the latter in some of its physical properties, *e. g.* in being brittle instead of sectile, and in its somewhat lower hardness. These differences may possibly be due to the minute state of dissemination of the Burmese mineral.

With respect to the relative age of the various minerals, nothing very definite can be observed, but the altaite and some of the other metallic minerals seem to be filling minute hollows or cracks in the quartz. In one instance the microscope showed a minute film of gold deposited between the cleavage planes of the altaite.

NOTES AND COMMENTS.

THE deplorable death of Baron Heinrich von Foullon, at the age of 46, has closed a career of active work in Mineralogy and Geology. Baron Foullon, who was Geologist at the Geological "Reichsanstalt" at Vienna, was a member of the unfortunate exploring expedition sent to the Solomon Islands by the Austrian Government. The whole party of explorers was massacred by the natives in August 1896.

Baron Foullon was a voluminous writer, and published papers on a number of subjects of mineralogical and geological interest, especially in relation to Petrology.

The death of Dr. J. W. Retgers, of Haag, removes an equally energetic student from the physical and chemical side of Mineralogy. Dr. Retgers, who was for many years occupied in Java, only devoted himself comparatively late in life to Chemistry and Crystallography, but displayed a marvellous activity, of which the record remains in a long series of papers upon Isomorphism and kindred subjects, published mostly in the *Zeitschrift für Physikalische Chemie.*

Another familiar name which disappears from the list of active workers is that of Dr. August Streng, for many years Professor of Mineralogy in the University of Giessen, where he was recently succeeded by Dr. Brauns. Professor Streng died on the 7th of January, at the age of 66.

A notable event is the completion of a volume of Professor Hintze's colossal *Handbuch der Mineralogie*, of which the first instalment was issued in 1889. Attention was called to the commencement of this great undertaking in Vol. IX. p. 48 of this Magazine, where it was mentioned that Professor Hintze hoped to complete the undertaking in 3 or 4 years. The first volume alone has occupied more than 7 years, and

this is by no means surprising. The volume contains no less than 1831 pages of closely printed material, and deals with the silicates and titanates with a luxuriance of detail never before attempted. Complete accounts of all the occurrences and associations are given for all the known localities, in addition to the general characters of each mineral. For example, the description of anorthite alone occupies 20 pages, contains 14 figures, a list of 94 angles, an account of 81 analyses, and a description of about 80 localities. The work is an invaluable book of reference, since it contains all that is to be found in other descriptive treatises and a great deal more besides, and appears to be extraordinarily accurate. The present volume is to be the second volume of the treatise, although it has been issued first.

A treatise of almost equal detail, but confined to the minerals of France and her colonies, is also completed, so far as the silicates and titanates are concerned, by the recent issue of the first part of the second volume of Professor A. Lacroix's *Minéralogie de la France et de ses Colonies;* the first volume of which was reviewed in Vol. X. p. 168 of this Magazine. This valuable treatise will ultimately consist of 3 volumes.

We have received a Catalogue of the Minerals of Tasmania, by W. F. Petterd (Launceston, 1896), a little book which contains a descriptive account of all the mineral occurrences hitherto known in that island.

REVIEWS.

Manual of Determinative Mineralogy, with an introduction on Blowpipe Analysis. By George J. Brush. Revised and enlarged by Samuel L. Penfield. 14th Edition. 164 pp. and Tables. London: Chapman and Hall. 1896.

Professor Brush's work on the determination of minerals by the aid of the blowpipe evidently meets a need, for it has run through 13 editions since its appearance in 1874, and it has now been found desirable to re-issue it in a semi-revised state under the editorship of Professor Penfield, whose name on the title page is a guarantee that the 14th edition will not fall behind its predecessors in usefulness.

The work in its present form consists of an introduction, followed by chapters on Apparatus and Reagents, Reactions of the Elements, Summary of Reactions and Tables for the Determination of Minerals.

The chapter entitled "Introduction and Chemical Principles" provides us with definitions of atomic weights, valence, chemical affinity, and the like, and instructs us how to calculate the formula of a mineral from its percentage composition. The judicious reader will skip all this, for if skilled in chemistry he will have nothing to learn from it, and if a beginner will be none the better for its perusal, and can more profitably occupy his time in learning the elements of his subject than in studying a book which should only be in the hands of those who have already obtained some knowledge of chemistry. The account of apparatus and reagents does not differ materially from that contained in other text books. The descriptions are clear, and so thoroughly illustrated by excellent drawings that no difficulty ought to be found in following them. In a book planned on a somewhat ambitious scale and of comparative costliness, we may fairly expect comprehensiveness of treatment, and it is therefore with a sense of disappointment that we search in vain for an account of the use of the spectroscope and for a table of spectra, and find no mention of Bunsen's flame reactions or of the aluminium plate support introduced by Ross. The distinctive and valuable feature of the book is, no doubt, the detailed account of the reactions of the elements and the summary of the same, contained in the third and fourth chapters.

The author does not limit himself to the blowpipe characters merely, but wisely includes the more important of the "wet" tests as well, and gives us in small print much excellent advice as to the quantities to take and the best conditions to employ to ensure the success of the experiments. These hints are evidently the result of much laboratory experience, and the student of mineralogical chemistry will do well to take them to heart.

The concluding chapter is occupied by Professor Brush's edition of von Kobell's well-known tables for the determination of minerals. Criticism of these is superfluous, more especially in view of the somewhat irritating statement made in the preface that the tables are even now under revision, and will be issued as soon as possible, together with a short chapter on crystallography and the physical properties of minerals.

We greatly regret that Professor Penfield was unable to complete the revision before the publication of this edition; for, had he done so, its value would have been greatly enhanced, and most mineralogists would have been content to wait indefinitely for the chapter on crystallography, if only the tables had been brought up to date. Even in its present state the book is one which ought to be found in every mineralogical institute in the English-speaking world. A. H.

Max Bauer. *Edelsteinkunde, eine allgemein verständliche Darstellung der Eigenschaften, des Vorkommens und der Verwendung der Edelsteine, nebst einer Anleitung zur Bestimmung derselben.* 711 pp. 20 coloured plates, 94 woodcuts. Tauchnitz, Leipzig, 1897.

This attractive book, to which attention was called in this Journal (Vol. XI. p. 92) on the appearance of the first part, is now complete. The excellent coloured plates, representing both natural and facetted stones, which were, according to the prospectus, to have been eight in number, have ultimately reached the number of 20, and are the most striking feature of the book. The only coloured plates of gem-stones, or indeed of minerals of any form, which can be compared with them are those which adorn Kunz's well-known work on the precious stones of North America.

Professor Bauer's treatise, though containing much that is of popular interest, is by no means a mere popular book for the general reader. It professes to be designed for mineralogists, lapidaries, and jewellers, and is full of scientific information. The first 124 pages are occupied with the general properties of minerals, in which the reader will find a full account of the various methods of determining the specific gravity, the

hardness, the optical and other physical characters, of gem-stones; a chapter on their applications—on the forms of facetted stones, and on the method of facetting; on their engraving, colouring and mounting; on imitation jewels, and on the comparative value of the various stones. All this is told in a simple and intelligible manner, and should be of the greatest practical value for the class of readers for whom it is designed; equally with the remainder of the book, this part may be recommended to every mineralogist as containing valuable and interesting information not easily found elsewhere; and it teems with useful hints and explanations.

It is doubtful whether the method of estimating specific gravity (given on p. 27) by means of four standard mixtures of methylene iodide and benzene is so reliable as might be imagined from the description. In practice such mixtures so rapidly increase in density owing to evaporation of the benzene that they would require continual re-determination, and it is far easier to work always by comparison with standard indices of known minerals, and to dilute the heavy liquid as required.

We miss one method that deserves description in a treatise on the determination of gem-stones, on account both of its scientific interest and practical value, namely, Kundt's method of exhibiting the pyroelectricity of tourmaline by dusting a cooling crystal with a mixture of red lead and sulphur. This is not alluded to either in the first chapter nor yet in the description of tourmaline, and yet it is in reality a most useful method of testing a tourmaline, and one which can often be easily applied even to a mounted stone.

We miss also any allusion to the method of determining the refractive power of a gemstone by means of total reflection. The reflectometer is an instrument so easily used and so convenient for the examination of stones, whose index of refraction is less than that of methylene iodide or of monobromo-naphthalene, that it might well have been described.

The remainder of the treatise deals with the various gem-stones in succession; and here the reader will find copious information about the occurrence and association of the different minerals on a far larger scale than has been previously attempted by books of this class. All the more important localities are explained by means of sketch maps, and the descriptions, historical, geographical and mineralogical, of the regions in which diamonds, rubies, lapis lazuli, and the other minerals have been worked, are most complete.

Under quartz (agate) will be found a very interesting illustrated account of the famous cutting and polishing industry of Oberstein.

The book is one which stands quite alone at present as a scientific

treatise on precious stones in all their modern aspects, and should be of great use.

Among the coloured figures special attention should be called to the highly successful representation of emeralds on Plate 12, of topaz on Plate 13, and of garnets on Plate 14.

The volume closes with a chapter on the identification of precious stones, and an appendix on pearls and coral. H. A. M.

Crystallography for Beginners by C. J. Woodward, B.Sc. London, 1896.

Few chemists are likely to question the value of the study of crystals as an aid to the accurate determination of the products of the organic laboratory. Many, however, seem to be of the opinion that crystallography is a subject of such an abstruse and mathematical character, that it is hopeless to attempt its mastery. This unfortunate misconception has no doubt been fostered to some extent by the lack of elementary text books to lead the beginner by easy stages up to the study of those more elaborate treatises which at first sight appear formidable to students without mathematical training. All, therefore, who are anxious to see fresh interest aroused in the study of crystals will welcome the little book before us, which in a simple, yet accurate and logical manner, sets forth within the limits of nine short lessons the chief facts and principles of the science.

Anyone who works conscientiously through the text and the illustrative examples at the end of each section, cannot fail to obtain a good grasp of the meaning of symmetry, the law of rational indices, the Millerian notation, and the method of representing the faces of crystals by means of the stereographic projection.

It should, however, be noted, that in making a projection of a crystal the eye is usually imagined as placed at the south pole of the sphere and not at the north pole, as represented in fig. 16. The concluding lessons are devoted to the forms of the cubic system, the choice of axes and parameters, Naumann's notation, the physical properties of crystals, and an explanation of the meaning of hemihedrism. At p. 100 the author's work and the scientific interest of the book cease together, for the appendix, some 60 pages, is given over to an entirely separate treatise, a translation from the German of Dr. Weisbach of a series of directions for identifying minerals by the application of simple tests. That tables of this sort have a certain value cannot be denied; but at the end of a work on crystallography they seem out of place—a chapter on organic

chemistry would hardly be more incongruous; and it is greatly to be regretted that they should have been allowed to monopolise space which could have been so much more profitably devoted to a consideration of twins, the forms of most of the systems, and the 32 crystal classes, all of them points passed over in silence in the body of the work. As far as it goes, however, the book is certain to prove useful to the beginner, and it will, we hope, do much to render more popular a fascinating and useful but neglected subject. A. H.

Abstracts.

Pearceite, and the crystallisation of Polybasite (S. L. Penfield, *Amer. Journ. Sci.* [4], II. 17-29, 1896). As corresponding sulpharsenites and sulphantimonites usually receive different designations, the name pearceite, after Richard Pearce, is proposed for the arsenical varieties of polybasite, $9Ag_2S.Sb_2S_3$—pearceite being $9Ag_2S.As_2S_3$. Minerals to which this name can be applied are:—the arsenical polybasite from Schemnitz, analysed by H. Rose in 1838; that of Aspen, Colorado, described by Penfield and S. H. Pearce in 1892; and the mineral described in the present paper. Two other old analyses show arsenic and antimony in about equal molecular proportions. The mineral here described occurs beautifully crystallised at the Drumlummon Mine, Marysville, Lewis and Clarke Co., Montana. Analysis by F. C. Knight gave—

S	As	Ag	Cu	Fe	Insol.	Total
17·71	7·39	55·17	18·11	1·05	0·42	99·85

This gives $S : As : (Ag_2+Cu_2+Fe)$ as very nearly $12 : 2 : 9$, as is required by the above formula, with $Ag_2 : Cu_2 : Fe = 255 : 143 : 19$. The monosymmetric crystals are usually flat hexagonal tablets, often with highly modified edges. There is a close approach to rhombohedral symmetry, so that it is often difficult to distinguish between the zones [001 : 100] and [001 : 110].

$$a : b : c = 1·7309 : 1 : 1·6199\,;\ \beta = 89°51'\,;\ mm = 60°2'.$$

On the basal plane are triangular markings, and the crystals show indications of twinning on the same law as the micas and chlorites. The colour and streak are black; lustre metallic; opaque, even in thin splinters. Sp. gr., 6·15. Brittle, with no distinct cleavage.

Polybasite, which has been described as being rhombohedral, and more recently as orthorhombic, is here shown to be monosymmetric. A crystal from Himmelfahrt mine, Freiberg, is described, which consists of a rhombohedron with the basal plane; this would be difficult to explain if the mineral were orthorhombic. It is pointed out that the monosymmetric minerals, mica, chlorite and leadhillite, which have prism angles of nearly 60°, exhibit this tendency to simulate rhombohedral symmetry,

which is not the case with the orthorhombic minerals, copper glance, aragonite and witherite. Measurements of unusually perfect crystals from Yankee Boy Mine, Ouray, Colorado, gave—

$$a : b : c = 1{\cdot}7309 : 1 : 1{\cdot}5796\,;\ \beta = 90°0'\,;\ mm = 60°2'.$$

These parameters of pearceite and polybasite show that there is a tendency for arsenic to increase the length of the vertical axis, and this is also to be noticed in several other cases—for example, in proustite and pyrargyrite. A close similarity is pointed out between these parameters and those of copper glance (Cu_2S) and stromeyerite (CuAgS) and many sulpharsenites and sulphantimonites, all of which have a prism angle of nearly 60°. This would seem to indicate that the sulphide of the metal has had a controlling influence on the crystallisation. L. J. S.

Rathite, a new Binnenthal Mineral (H. Baumhauer, *Zeits. für Kryst.* XXVI. 593-602, 1896). The sulpharsenites of lead — jordanite, dufrenoysite, and sartorite—are all very similar in appearance, and a close examination of them leads to the conclusion that there is at least one more—namely, rathite—to be found amongst these Binnenthal minerals. Characteristic of rathite, but not invariably present, are parallel systems of very fine striæ, which are visible, with a suitable oblique illumination, on the crystal faces and on the fractured surfaces ; this striation is oblique to the zone axis on the macrodomes, and is evidently due to a lamellar structure (which may be isomorphous banding or twinning) of the crystals, in which the lamellæ are parallel to the faces of a brachydome, possibly (011). The crystals are orthorhombic, and resemble those of the minerals mentioned above in being elongated and striated parallel to the macro-axis, and in often being indistinctly terminated. The list of crystal forms includes the basal plane, 4 brachydomes and 20 macrodomes.

$$a : b : c = 0{\cdot}668099 : 1 : 1{\cdot}057891.$$

Multiplying a and c by $\frac{3}{2}$, there is a close relationship between these parameters and those of dufrenoysite. The crystals are twinned, probably on a brachydome, so that the striated zones of two individuals intersect at an acute angle ; there is, however, no relation between this twinning and the fine striation.

Sp. gr. 5·32. Analysis by A. Bömer gave :

Pb.	S.	As.	Sb.	Fe.	Total.
52·98	23·72	17·24	4·53	0·56	99·03

A mixture of 5 molecules of dufrenoysite ($2PbS.As_2S_3$) and 1 of jamesonite ($2\,PbS.\,Sb_2S_3$) does not correspond so closely to this composi-

tion as does a mixture of 5 molecules of $2PbS.As_2S_3 + 2PbS.As_2S_5 = 4(PbAsS_3)$ and 1 of $2PbS.Sb_2S_3 + 2PbS.Sb_2S_5 = 4(PbSbS_3)$. It is supposed that the fine striæ are due to the alternate banding of these two isomorphous compounds, and that the partial replacement of As_2S_3 and Sb_2S_3 by As_2S_5 and Sb_2S_5 accounts for the morphotropic relationship between rathite and dufrenoysite. The mineral is named after the late G. vom Rath. L. J. S.

Wardite, a new aluminium phosphate (J. M. Davison, *Amer. J. Sci.* II. 154-155, 1896). This occurs in cavities in the nodules of variscite from Utah; it is light green or bluish green in colour with a vitreous lustre. The structure is concretionary; sp. gr. 2·77; H. about 5, being a little harder than the variscite. Analysis gave—

P_2O_5	FeO	CuO	MgO	Na_2O	K_2O	H_2O	Al_2O_3 [diff.]
34·46	0·76	0·04	2·40	5·98	0·24	17·87	[38·25]

Formula, $P_2O_5.2Al_2O_3.4H_2O = Al_2(OH)_3PO_4 + \frac{1}{2}H_2O$; or perhaps $AlNaPO_4.Al(OH)_3.\frac{1}{2}H_2O$. The following series is made out:—

Peganite	$Al_2(OH)_3PO_4 + 1\frac{1}{2}H_2O$
Turquoise	$Al_2(OH)_3PO_4 + 1H_2O$
Wardite	$Al_2(OH)_3PO_4 + \frac{1}{2}H_2O$

Before the blowpipe the mineral swells up and turns white; it is only partially decomposed by aqua regia. The name is given after H. A. Ward. L. J. S.

Northupite, Pirssonite and Hanksite from California (J. H. Pratt, *Am. J. Sci.* II. 123-135, 1896). The minerals here described are found associated with borax and gaylussite at Borax Lake, San Bernardino Co., California. Borax Lake is an alkali marsh which is usually dry, but some water collects in it during the wet seasons.

Northupite (see Abstr. XI. 159).—An analysis of this new mineral agrees closely with the formula $MgCO_3.Na_2CO_3.NaCl$; potassium is absent. Sp. gr. 2·380. It is isotropic, and for sodium light $\mu = 1·5144$. [Artificial northupite has been recently prepared by A. de Schulten (*Bull. Soc. franç. Min.* XIX. 164, 1896.)].

Pirssonite. This new mineral has been found as isolated orthorhombic crystals with northupite. It is hemimorphic, and shows the forms $b\{010\}$, $m\{110\}$, $p\{111\}$, $p^{\circ}\{11\bar{1}\}$, $e\{131\}$, $x\{311\}$; $a : b : c = 0·56615 : 1 : 0·3019$. The crystals vary considerably in habit, being prismatic, or tabular parallel to b. The form e is developed at only one end, this being the

pyro-electric analogous pole. The mineral is colourless to white, but is often darkened by impurities; it is brittle, and shows no cleavage; Sp. gr. 2·352; H = 3 – 3·5. The plane of the optic axes is the base, and the axis *b* is the acute bisectrix; optically positive; $2E_{Na} = 48°16'$ at 20° C., and 47°38′ at 90° C. Chemical analysis gives the formula $CaCO_3.Na_2CO_3.2H_2O$; this is like gaylussite, which, however, has $5H_2O$; the two minerals are also somewhat similar in appearance, and occur together. Practically all the water is expelled below 150°. The name is given after L. V. Pirsson. [De Schulten has prepared artificial pirssonite alone, and also simultaneously with northupite and gaylussite; in the latter reaction rhombohedral crystals of $MgCO_3.Na_2CO_3$ were also formed, and it is predicted that this will be found as a natural mineral at Borax Lake (*Compt. Rend.* CXXIII. 1023, 1896).]

Hanksite.—The formula usually accepted for this mineral is $4Na_2SO_4.Na_2CO_3$; and the potassium and chlorine in the two previous analyses have been considered as impurities (salt and sylvine). The author, however, finds that chlorine is present in all crystals, and that microscopical examination shows the presence of only slight impurities. The following analyses have been made on pure material, I. on tabular crystals, and II. on prismatic crystals—

	SO_3	CO_2	Na_2O	Cl	K	Insol.	Sp. gr.
I. ...	45·95	5·65	43·35	2·21	2·48	0·19	2·567 – 2·553
II. ...	45·78	5·63	43·61	2·28	2·39	0·12	2·545

The close agreement of both these with previous analyses indicates that chlorine and potassium are not accidental. The formula is now given as $9Na_2SO_4.2Na_2CO_3.KCl$. Few minerals contain three acid radicles, as this does.

[Artificial hanksite prepared by de Schulten has the composition $4Na_2SO_4.Na_2CO_3$ (*Compt. Rend.* CXXIII. 1325, 1896).] L. J. S.

Gold in Granite (G. P. Merrill, *Amer. J. Sci.* [4], I. 309-311, 1896). A specimen labelled "Gold ore, Sonora, Mexico" is an ordinary black-mica granite which, owing to weathering, is brown and friable; throughout the mass are numerous specks, rarely over 1 mm. in diam., of native gold. Pyrites and other sulphides are absent. Microscopical examination of thin sections of the rock shows the gold enclosed in the quartz and felspar as beautiful arborescent and platy forms; it therefore does not seem to be a secondary constituent, which has been deposited along fissures, but to be a primary constituent which has crystallised from the original magma. Such a mode of occurrence of gold does not seem to have been previously described. L. J. S.

Valleite, a new orthorhombic Amphibole (G. Cesàro, *Bull. Acad. Sci. Bely.* [3], XXXII. 536-545, 1896, and XXIX. 508-510, 1895). This mineral occurs with the violet tremolite (hexagonite) of Edwards, St. Lawrence Co., N.Y. It closely resembles anthophyllite in appearance, but differs from it in the optical characters, and in containing only a little iron. The indistinct crystals are flattened parallel to (100), and have a perfect cleavage in this direction. Other cleavages are (010), (021), and less distinct (110), (011), (031) and (001). The prism angle is 54°30′; $a:b:c=0{\cdot}515:1:0{\cdot}255$. The plane of the optic axes is (010), and the acute negative bisectrix is perpendicular to (100); $2E=90°28'$; H=4·5; sp. gr., 2·88. It is easily fusible to a white, nearly opaque, bead. Analysis by Renard gave—

SiO_2	MgO	CaO	Fe_2O_3	MnO	K_2O	H_2O	Total
58·02	27·99	5·04	1·28	2·88	0·89	3·13	99·23

This agrees with the metasilicate formula $RO.SiO_2$. L. J. S.

Heavy Liquids for the separation of Mineral Sulphides (J. W. Retgers, *Neues Jahrb. Min.* I. 212-221; II. 183-195, 1896). As molten silver nitrate and silver-thallium nitrate (m.p. 70°, sp. gr. 4·8) act on mineral sulphides, these liquids have only a limited application. The author has examined numerous simple and double nitrates and acetates of the heavy metals, with the object of finding a colourless, mobile liquid of high density, which is miscible with water, and would be applicable in the case of sulphides. The most useful is thallium-mercurous nitrate (m.p. 76°, sp. gr. 5·3). Thallium acetate (m.p. 110°, sp. gr. 3·9) has too low a density, and thallium nitrate-acetate (m p. 65°, sp. gr. 4·5) decomposes at temperatures above 100°. Mercurous nitrate, $HgNO_3+H_2O$ (m.p. 70°, sp. gr. 4·3) is much less expensive than the other salts. L. J. S.

Crystallography of Bournonite (F. B. Peck, *Zeits. f. Kryst.* XXVII. 299-320, 1896). Taking *c*(001) and *b*(010) of bournonite to be (100) and (001) respectively, it is seen that there is a close crystallographic, as well as chemical, relationship between this mineral and the monosymmetric members of the red silver group.

		a	:	*b*	:	*c*	*β*
Xanthoconite	Ag_3AsS_3	1·9187	:	1	:	1·0152	88°47′
Fireblende	Ag_3SbS_3	1·9465	:	1	:	1·0973	90 0
Bournonite	$PbCuSbS_3$	½(1·9122)	:	1	:	1·0662	—

This suggests that bournonite may be monosymmetric; but the angular

measurements, some of which were made at different temperatures, and the results of thermal conductivity experiments, are in agreement with orthorhombic symmetry. The crystals of bournonite from various localities are described in detail. L. J. S.

Tilasite or Fluor-adelite from Långban (H. Sjögren, *Geol. Fören. i Stockholm Förh.*, 1895, XVII. 291-294; Abstr. in *Neues Jahrb. Min.* 1897, I. 25-26). Irregular grains, 5-10 mm. across, of this new mineral are found with hausmannite, berzeliite and calcite in a grey limestone at Långban, Sweden It is grey to pale violet in colour; the lustre on the fractured surfaces is greasy, and on the cleavage surfaces vitreous. The formula is $2CaO.MgO.MgF_2.As_2O_5$, this being like that of adelite, but with fluorine in place of (OH). The optical examination of cleavage flakes shows the mineral to be anorthic. L. J. S.

Mauzeliite (H. Sjögren, *Geol. Fören. i Stockholm Förh.* 1895, XVII. 313-318; Abstr. in *Neues Jahrb. Min.* 1897, I. 26-27). Mauzeliite occurs, with a rose-red mineral which is probably svabite, in a calcite vein 1—2 cm. wide, in a mixture of hausmannite, calcite, garnet, schefferite and manganophyllite, at Jakobsberg, Sweden. The isometric crystals are 5—10 mm. across, and show the forms (111), (100), with sometimes (311). (111) is usually even, (100) pitted, and (311) striated parallel to its intersection with (111). The mean of two analyses made by Mauzelius has already been quoted on page 83 of this volume; neglecting the fluorine, which could not be determined, the formula is deduced as $Ti(SbO_4R'')_4 = 4R''O.2Sb_2O_5.TiO_2$. L. J. S.

Hullite (G. A. J. Cole, *Proc. Belfast Nat. Field Club*, 1894-5, IV, 221; *cf.* Abstr. II, 152, 247). This substance has been described as filling amygdaloidal cavities, and as occurring interstitially among the minerals of the basalt. Having in view the latter mode of occurrence, the author suggests that hullite is really the altered and hydrated glass of the original basaltic groundmass; the chemical composition being near to that of a palagonite. The occurrence of a glass in vesicles has already been described by Teall in the Tynemouth dyke. L. J. S.

The so-called Schneebergite (A. S. Eakle and W. Muthmann, *Zeits. für Kryst.*, XXIV, 583-6, 1895). This mineral, which occurs as small honey-yellow, regular octahedra at Schneeberg, Tyrol, was stated by Brezina to consist principally of calcium, antimony and a little iron (*cf.*

Abstr. V, 112); it has, therefore, been considered to be near, or to be identical with, atopite. From the analysis of the present authors, it is, however, seen to be really a calcium-iron-garnet, no Sb, Bi, or Cu having been detected.

SiO_2	Fe_2O_3	CaO	Sp. gr.
35·45	32·22	32·58	3·838

The material consists of aggregates of rounded crystals, associated with magnetite, blende, copper pyrites and quartz; on other specimens it is as a thin coating, with here and there distinct octahedra. The crystals are isotropic, with the exception of anomalous double refraction round enclosed grains of magnetite, blende, &c. The mineral is always associated with calcite and breunnerite, which it often surrounds, and from which, under the microscope, it is distinctly seen to have been derived. The occurrence of a topazolite without any alumina and in octahedra is of interest. L. J. S.

Composition of Idocrase (Mats Weibull, *Zeits. f. Kryst.*, XXV, 1-37, 1895). The author has examined the idocrase from the limestone quarry of Tennberget, Dalarne, Sweden, its mode of occurrence and that of the associated minerals being minutely described: of interest is the fact that the calcite in contact with the idocrase is very pure, containing only MgO (0·14 per cent.). The crystals are rich in forms (the prism 650 new), and the measurements agree completely with the tetragonal system: $a : c = 1 : 0{\cdot}53539$ (from $cp = 37°7'54''$), there being only a slight variation in the angles of different crystals. The mineral is uniaxial and negative, and shows no division into fields. Colour, brown; sp. gr. 3·325. The mean of six partial analyses on a crystal with $cp = 37°10'30''$ gave the results under I. For this the orthosilicate formula $12CaO.3Al_2O_3.10SiO_2.(H_2O,F_2)$ is deduced, the alkalies being reckoned as R''O. The loss on ignition is slightly greater than H_2O+F, and experiments were made which tend to show that the white fumes evolved on ignition consist of AlF_3.

	SiO_2	Al_2O_3	B_2O_3	Fe_2O_3	FeO	CaO	MnO	MgO	K_2O
I.	37·38	16·92	—	1·78	3·36	35·01	0·06	2·20	0·23
II.	37·97	16·25	0·10	3·87	0·55	35·34	—	2·46	0·13

	Na_2O	H_2O	F	Total	Total (0 less F)
I.	1·15	0·77	1·72	101·03	100·30
II.	0·28	1·08 1·60	—	99·63	

Previous analyses, in which the water and fluorine have been directly determined, are reduced to the above formula. A structural formula showing the relation to garnet is given.

Some fluorine-free idocrases have also been examined; crystals from Oziklowa, Hungary, with $a : c = 1 : 0{\cdot}5340$, $cp = 37°0'$, and showing optical anomalies, gave the analysis II. This analysis agrees with the above formula when the water is considered as partly an acid and partly a basic constituent; this is supported by the fact that part of the water (1·08 per cent.) goes off at a red-heat, while the remainder is only expelled at a very high temperature over the blowpipe, the former part being considered to be the basic and the latter the acid water. An optically normal crystal ($cp = 37°13'$) from Zermatt lost water in the same manner. Previous analyses of fluorine-free idocrases are discussed, and in the formula of some the radicles Al(OH), Mg(OH) or Ca(OH) are supposed to exist with the bases. It is noticed that although the amounts of the other bases vary, the calcium is pretty constant (35 per cent.); this represents $\frac{5}{6}$ R″, and the general formula is $Ca_5R''Al_2[R'''(OH,F)]Si_5O_{20}$. No connection can be traced between the variation of the ratio $a : c$ and the chemical composition. L. J. S.

Crystalline form of Riebeckite. (W. J. Sollas, *Proc. Roy. Irish Acad.* [3], III, 516-523, 1895.) Rock fragments from the glacial deposits of the east coast of Ireland are identified with the micro-granite of Ailsa Craig (*Min. Mag.* IX. 219) in containing riebeckite, but they otherwise closely resemble the granophyre of the Mourne Mountains district. In these rock fragments are numerous drusy cavities containing crystals of quartz, felspar and riebeckite, the latter up to 5mm. in length. The crystals are somewhat irregular, the faces not being quite parallel, but there is no reason for not considering the mineral as monosymmetric.

$$a : b : c = 0{\cdot}54748 : 1 : 0{\cdot}29246\,; \quad \beta = 76°10'.$$

Forms, b(010), c(001), m(110), Z(150), $r(\bar{1}11)$, $t(\bar{2}01)$, z(021), with b m c about equally developed, the other planes being small; $mm = 56°$. Partial analyses gave:

SiO_2	Al_2O_3, Fe_2O_3	Na_2O	K_2O
42·69	41·71	10·00	0·87

Brögger's statement that the extinction angle of the hornblendes varies with the amount of soda and iron is represented graphically. L. J. S.

Pyrochlore from Alnö, Sweden. (P. J. Holmquist, *Geol. För. Förh.*, XV, 588, 1893; abstr. in *Neues Jahrb. Min.* II, 15-16, 1895.) In the

metamorphic limestone of the syenite district of the above locality occu numerous octahedral crystals of pyrochlore, together with titaniferou magnetite, apatite, olivine, manganophyllite, zircon and perofskite Besides (111) the forms (110) and (100) are present. The large crystals (1 – 2 cm. across) are of a light brown to black colour and have sp. gr. of 4·3528 – 4·3533 (analysis I), while the smaller crystals ar transparent and of a light reddish-yellow colour, having a sp. gr. o 4·4460 (II). In sections, the mineral is fresh and isotropic, and a octahedral cleavage is sometimes apparent. A zonal structure is seen which in the larger crystals presents itself as alternate brown and light yellow zones, the former broader towards the centre of the crystal and the latter broader towards the periphery; also sometimes the smaller crystals have a dark kernel which shows the zonal structure.

	Nb_2O_5	TiO_2	ZrO_2	FeO	Ce_2O_3	ThO_2	CaO	Na_2O	C
I.	58·83	3·70	2·90	4·20	3·99	0·41	16·75	3·44	
II.	63·64	—	4·90	1·14	4·36	—	18·13	4·99	

	K_2O	H_2O	F	Total.	Total (less O for F).
I.	1·41	0·78	4·34	100·75	98·92
II.	0·60	0·47	4·31	102·54	100·73

These analyses may be represented by the general formula $m(2RO.Nb_2O_5)$ $+RO.(Zr,Ti)O_2$. In II. there is enough fluorine to replace all the oxygen in the metazirconate, and $m = 6$, so that the formula becomes $6\,(2RO.Nb_2O_5)+RF_6Zr$, or

$$\left\{\begin{array}{l} 5\,(2CaO.Nb_2O_5) \\ 2Na_2O.Nb_2O_5 \\ \cdot Na_2F_6Zr \end{array}\right.$$

For I., if Ti : Zr = 2 : 1, the formula may be written

$$\left\{\begin{array}{l} 3\,(7CaO.Na_2O.4Nb_2O_5) \\ Na_2O.TiO_2 \\ Na_2F_6Ti \\ Na_2F_6Zr \end{array}\right.$$

As the fluorine and alkalies of pyrochlore and other minerals exist in the atomic ratio of 1 : 1, it is suggested by the author that in the action of alkaline fluorides as mineralising agents (in pneumatolitic processes and contact-metamorphism) the alkalies as well as the fluorine go to form the resulting minerals. L. J. S.

Rubies of Burma; their occurrence, origin and metamorphosis (C. B. Brown and J. W. Judd, *Proc. Roy. Soc.*, LVII, 387-394, 1895, and *Phil. Trans. Vol.* 187, A, 151-228, 1896). The famous

ruby district of Upper Burma is situated 90 miles N.N.E. of Mandalay, the principal mining centre being Mogok. The gneissic rocks of the district are of intermediate chemical composition, including biotite-gneiss, biotite-granulite and rarely biotite-schist, hornblende being rare or absent, but garnet abundant. Interfoliated with these are more acid rocks, such as coarse pegmatites, aplites, quartzite, etc.; also more basic rocks, as pyroxene-gneiss and pyroxene-granulite, these passing into pyroxenites and amphibolites; and lastly bands of crystalline limestone. The acid rocks contain tourmaline, as in the adjacent rubellite district of Nyoungouk, where rubellite and indicolite occur; the basic rocks are rich in garnet, and the felspar (near anorthite) is often altered into scapolite, giving rise to scapolite-gneiss, etc. The limestones, in which alone the rubies and spinels occur, are more closely associated with the basic and ultra-basic rocks, these containing crystals of calcite, and as the amount of calcite increases, passing into the limestones; it being supposed that the limestones have been derived by the alteration of the felspar in the basic rocks. These lime felspars, having a great tendency to "werneritisation," give rise to a separation of calcium carbonate and hydrated aluminium silicates, the former being deposited as calcite and the latter as hydrated aluminium oxides (diaspore, gibbsite, &c.) which may be afterwards converted into anhydrous alumina. In the limestones, which are often highly micaceous, are found, graphite, pyrrhotite, corundum (ruby, sapphire, white sapphire, oriental topaz and oriental amethyst), spinel of various colours, rarely zircon, garnet, blue apatite, felspars (moonstone, etc.), quartz, micas (phlogopite, fuchsite, muscovite), hornblende, arfvedsonite, augite (sahlite and diopside), ægirine, enstatite (bronzite and hypersthene), wollastonite, lapis lazuli, fibrolite, scapolite, and also alteration products such as diaspore, margarite, chlorite, vermiculite and carbonates; there being an absence of fluorine and boron minerals.

The subsequent alteration of the rubies is seen as an inner zone of diaspore passing outwards into various hydrous aluminium silicates—margarites, clintonites, vermiculites, muscovites, kaolinites, etc.; these changes sometimes taking place in an irregular manner, but mostly along the primary and secondary solution planes (*Min. Mag.*, XI, 49), breaking the whole crystal up into an aggregate of simple forms. The associated spinel, quartz and felspar also exhibit external etching and internal chemical change. L. J. S.

Sylvite from Stassfurt. (W. Schimpff, *Zeits. f. Kryst.*, XXV, 92-3, 1895.) The sample examined is of interest as containing in negative

crystals a relatively large proportion of hydrogen sulphide, which gas, on the solution of the salt, escapes under pressure with a crackling noise: this phenomenon is the same as that presented by the "knistersalz" variety of halite. The negative crystals present the same forms, $a(100)$ and $o(111)$, as the host. Under the microscope, as solution goes on, the walls of the cavities, when they become thin, are seen suddenly to give way, allowing a bubble of gas to escape. There are also larger cavities containing air and perhaps other gases; and others enclosing mother liquor, to which the impurities in the analysis are attributed. The hydrogen sulphide amounts to 3·01 per cent. by volume. Analysis gave

KCl	...	99·2390
NaCl	...	0·2424
$MgCl_2$	...	0·0890
$CaSO_4$	...	0·0730
H_2S	...	0·0023
Insoluble	...	0·1080
Loss on fusion		0·2847
		100·0331

L. J. S.

Celestite from Giershangen, Westphalia. (A. Arzruni and K. Thaddéeff, *Zeits. f. Kryst.*, XXV, 38-72, 1895.) The celestite from this locality is of interest as being chemically pure strontium sulphate, neither calcium nor barium being detected spectroscopically. The crystals are prismatic in the direction of the c axis, and are mostly colourless; $a : b : c = 0{\cdot}77962 : 1 : 1{\cdot}28533$. Sp. gr. 3·9665. $2V_{Na} = 50°46'$; $2E_{Na} = 87°44'$ The variations in the crystal angles of celestite are discussed in detail, and it is pointed out that this variation, which is usually considered (but not at all proved) to be due to the presence of calcium or barium, occurs, not only on crystals from different localities, but on crystals from the same specimen and even on the same crystal. A crystal from the above locality gave $mm = 75°4' - 76°14'$, another $75°21' - 76°38'$; the angles corresponding to the numerous published parameters show a greatest difference of $mm = 75°43' - 76°33'$ and $dd = 78°2' - 79°12'$. The cause of this variation is explained by the crystals being built up of smaller elements not quite in parallel position, but in fan-like arrangements about one or other zone-axis; the influence of any isomorphously contained calcium, &c. being quite subordinate. The variations in the optic axial angle ($2V_{Na} = 49°21' - 51°12'$, $2E = 84°43' - 90°4'$ of different authors) and of specific gravity are more likely to be due to the presence of calcium, etc.,

though the not quite parallel growth will have some influence on the former ; no connection between these variations and the composition has however been traced. From the published measurements the following constants for " normal " celestite are deduced, $a : b : c = 0{\cdot}78093 : 1 : 1{\cdot}28324$. $2\,V_{Na} = 50°34'$, $2E = 87°45'$. Sp. gr. 3·9665.

The existence of barytocelestite as a true isomorphous mixture is doubted. L. J. S.

Garnet simulating Jade (F. W. Clarke, *Am. J. Sc.*, L., 76, 1895). A waterworn pebble from 40 miles south of Los Angeles, California, closely resembled jade in being highly polished, very compact, and of an apple-green colour ; analysis, however, showed it to be grossular garnet. Sp. gr. 3·485. L. J. S.

Cerussite with a superficial film of Galena (W. H. Hobbs, *Am. J. Sc.*, L, 121-3, 1895). Twinned prismatic crystals of cerussite from near Missoula, Montana, were partially coated with an extremely thin, glistening film of metallic lustre, the trace of sulphur and the excess of lead in the analysis showing this to consist of galena.

PbO	CO_2	Fe_2O_3,Al_2O_3	SiO_2	S	Total
80·83	15·51	0·55	2·15	tr.	99·04

The parts of the crystals so coated gave good reflections, but other parts did not. As this film of galena is not found on any of the associated minerals, it may be considered to be due to the alteration of the cerussite, probably by the action of hydrogen sulphide. A somewhat similar epimorph, but with the cerussite afterwards replaced by calcite, has been described by Blum. L. J. S.

Calaverite from Cripple Creek, Colorado (W. F. Hillebrand, *Am. J. Sc.*, L, 128-131, 1895). Tellurium has been previously known to occur in the ores of this district, partly in association with gold as gold-tellurium (sylvanite). Analyses of calaverite were made on the material collected from three mines, viz. Prince Albert Mine, I., Raven Mine, II., and C.O.D. mine, III.

	Te	Au	Ag	Insol.	Fe_2O_3	Fe	S	Total
I.	57·27	38·95	3·21	0·33	0·12	—	—	99·88
II.	47·69	33·93	1·47	5·80	—	5·41	6·17	100·47
III.	53·89	39·31	0·85	0·91	—	1·67	1·58 ; also Mn, Ca, Mg, &c.	

After deducting impurities (pyrites, etc.) these analyses reduce to the formula (Au, Ag) Te_2 ; the amount of silver in I. being very close to that

in Genth's analyses. Selenium occurs in the district, but not in the calaverite. The mineral, which is of sparing occurrence, is of a pale bronze-yellow colour, the powder being greenish-gray. H = 3; Sp. gr. 9·00. In a note on the crystallography Penfield states the crystals to be prismatic in habit, the prism zone being deeply striated and irregular in cross section, while end faces are small and irregularly developed. The perfect cleavage of sylvanite and krennerite is absent, but there is a similarity in some of the angles to those of the former mineral. When placed in position to show the relation to sylvanite the prism zone is parallel to the *b* axis (of sylvanite); one crystal was then apparently a twin about 101 with the end faces 111 and 110, but other forms could not be referred to these axes. The system is given as probably asymmetric. L. J. S.

Marshite (*Copper Iodide*) *from Broken Hill, N. S. Wales.* (C. W. Marsh, *Journ. and Proc. Roy. Soc. N. S. Wales*, 1892, XXVI, 326-329). This new mineral occurs as small, translucent, reddish oil-brown crystals, of about $\frac{1}{2\frac{1}{4}}$″ diam., on cerussite; the crystal form is given as tetragonal-hemihedral (compare, however, Miers, *Zeits. f. Kryst.* 1894, XXIV, 207, who gives it as cubic and tetrahedral). The lustre is resinous; streak orange-yellow; brittle, with sub-conchoidal fracture. When heated, violet fumes of iodine are given off; and it is soluble in hot nitric acid with evolution of iodine. Some of the earlier formed mineral has been altered to black copper oxide. Prof. A. Liversidge, in an accompanying note proposes the name marshite. L. J. S.

Willyamite, a new Broken Hill Mineral. (E. F. Pittman, *Journ. and Proc. Roy. Soc. N. S. W.*, XXVII, 366-368, 1893). This new mineral is found with dyscrasite in a calcite and chalybite vein. The crystal system is regular, and there is a perfect cubic cleavage; fracture uneven. Colour between tin-white and steel-grey, streak greyish-black; lustre metallic. H = $5\frac{1}{2}$; Sp. gr. 6·87. The formula CoS_2, NiS_2, $CoSb_2$, $NiSb_2$ corresponds to ullmannite with half the nickel replaced by cobalt. The mineral is named from Willyama, the official name of the Broken Hill township. L. J. S.

Alexjejewite. (V. Aleksyeev, *Verh. d. kais. russ. min. Ges.* [II], XXIX, 201-3, 1892; abstract in *Zeits. für Kryst.*, XXIV, 504, 1895). This new wax-like substance, from the Gov. Kaluga in Russia, resembles compact turf in appearance, it is soft and porous and of a white to brown

colour. It contains, scattered in the interior, a compact light-yellow material having the same chemical and physical characters. Sp. gr. 0·950 (at 20° C.); melting point 64°–65°. Analysis gave: 75·5, C; 12·5, H; 12·0, O, and about 0·7 per cent. of ash. It is sparingly soluble in alcohol and benzene, and when heated gives off water and a white liquid of sp. gr. 0·786 (at 20°), boiling point 240°, and composition 83·4, C; 13·8, H. The name alexjejewite is proposed by A. Karnojitzky in the abstract quoted. L. J. S.

Epidote and Zoisite. The question of the relation between these two minerals has been reopened by E. Weinschenk in connection with an epidote very poor in iron from the Goslerwand in the Tirol (*Zeits. f. Kryst.* Vol. XXVI, p. 156, 1896). Like Brögger, he makes the crystallographic comparison by taking the ordinary c and b axes of zoisite as b and a respectively, and making the i-plane $(\bar{1}02)$ of epidote the base. The axial ratios then reduce for zoisite to

$$a : b : c = 2{\cdot}9158 : 1 : 1{\cdot}7900,$$

and for epidote to

$$a : b : c = 2{\cdot}8914 : 1 : 1{\cdot}8057,$$

with $\beta = 81°3'$, and the principal angles agree very closely for the two minerals. He combats Mallard's theory that zoisite is merely epidote with ultramicroscopic lamellar twinning parallel to (100). This may be reconciled with the crystallographic observations and the different cleavages of the two minerals, but not with their optical properties. The two silicates $H_2Ca_4Al_6Si_6O_{26}$ and $H_2Ca_4Fe_6Si_6O_{26}$ must be recognised as isodimorphous, their mixtures tending to crystallise in the rhombic or in the monoclinic system according as they are poor or rich in iron. The author's analyses are given below: I being epidote from the Rothenkopf, Zillerthal; II. the Goslerwand epidote, to which the name clinozoisite is given, agreeing in composition with many zoisites; III. the zoisite of the Gorner glacier, Zermatt; IV. the zoisite of the Kleinitz, near Prägraten, Tirol. The conclusion is that the epidotes form an isomorphous series with graduated physical and optical properties depending upon the percentage of iron oxide. Clinozoisite bears the same relation to the varieties richer in iron that enstatite does to bronzite and hypersthene. With increasing richness in iron the mean refractive index increases from 1·7195 to 1·7573; the birefringence from 0·0056 to 0·056; the colour and pleochroism become more marked; and the

mineral passes from positive to negative, the angle 2V diminishing from 108° to 73°.

		I.	II.	III.	IV.
SiO_2	...	38·60	39·06	39·31	39·42
Al_2O_3	...	31·71	32·57	32·48	33·23
Cr_2O_3	...	—	—	—	0·41
Fe_2O_3	...	3·52	1·68	2·78	1·07
FeO	...	0·35	0·29	not det.	—
MnO	...	trace	trace	—	—
MgO	...	—	—	0·22	—
CaO	...	24·22	24·53	23·07	24·25
H_2O	...	1·95	2·01	2·54	2·11
		100·35	100·14	100·40	100·49
$\gamma - a$	...	0·0105	0·0056	0·0088	—
Spec. gr.	...	3·3985	3·3720	3·3720	3·3410

A. H.

The grouping of the Garnets. E. Weinschenk has recently reviewed the mutual relations of the various members of the garnet group and the connection of their optical anomalies with their chemical composition and mode of occurrence (*Zeits. für Kryst.* Vol. XXV, p. 365, 1895). Taking the lime-alumina-garnet as a type, it is well known that the CaO may be more or less replaced by FeO, MnO, or MgO, the Al_2O_3 by Fe_2O_3, Cr_2O_3, and perhaps Ti_2O_3, and in rare cases the SiO_2 by TiO_2. These various replacements, however, are not all found to occur in any proportions, as in true isomorphism. The lime garnets are pretty sharply divided from those containing ferrous or manganous oxide or magnesia, while the members of the latter sub-group are chemically isomorphous with one another. Again, in the former sub-group are found all possible transitions between lime-alumina-, lime-iron-, lime-chrome-, and lime-titanium-garnet, while in the second sub-group alumina is always by far the dominant trivalent oxide. The only connecting link between the two sub-groups is between the lime and the manganese garnets: here intermediate varieties, though not common, occur in very different proportions. The modes of occurrence in nature of the several members of the garnet group are various: they are found either as rock-forming minerals or crystallised in fissures, &c.; and under the former head they are either primary constituents of igneous rocks or products of metamorphism.

The author examines the occurrence and optical properties of the several members. The lime-garnets divide into those with and those without titanium, the former being frequently primary constituents of nepheline-syenites, phonolites, &c., while the latter are always secondary products. The titaniferous varieties are isotropic, the non-titaniferous birefringent and with polysynthetic structure. The manganese-garnets (spessartine) occur both as primary constituents of acid rock and as products of metamorphism. In the former case they are optically normal, in the latter abnormal. The ferrous garnets (almandine, &c.), whether as original rock constituents, as metamorphic minerals, or as the contents of druses and fissures, seem to be constantly isotropic. The magnesia-garnet, found always as a primary mineral in peridotites, &c., is also constantly isotropic.

Further data seem to be required before it can be decisively stated how far the optical anomalies of garnets are connected with chemical composition, and how far with the conditions of crystallisation. The peculiar polysynthetic structure, giving sectors with different optical orientation, seems to be confined to the non-titaniferous lime-garnets, and a portion of the manganese-garnets, often lime-bearing. On the other hand, the comparison of spessartines from different localities seems to indicate that garnets of closely similar composition may be isotropic when they are formed from an igneous magma, but present anomalies when they are produced by metamorphic or pneumatolytic processes. A. H.

Optical Characters of the Olivine Group (S. L. Penfield and E. H. Forbes, *Amer. Journ. Sci.* [4], I, 129-135, 1896; and *Zeits. f. Kryst* XXVI, 143, 1896). The following table shows that in the olivine group (excluding monticellite) as the amount of iron decreases there is a gradual increase in the value of the optic axial angle, which changes less rapidly at the magnesium end of the series; the value of β and the strength of double refraction decrease with the iron.

	FeO per cent.	$2V_{Na}$ over a	β
Fayalite, Rockport, Mass.	68·1	49°50′	1·864
Hortonolite, Monroe, N.Y.	47·3	69°24′	1·791
Olivine, Auvergne	13·0	89°36′	1·692
,, Vesuvius	12·6	89°42′	
,, Hawaii	10·3	91°2′	
,, Egypt	9·2	91°19′	1·678
,, New Mexico	8·6	91°24′	
Forsterite, Vesuvius (Des Cloizeaux)	2?	93°50′	1·657

In the olivine group we always have $a=\mathfrak{c}$, $b=\mathfrak{a}$, $c=\mathfrak{b}$, but when there is less than about 12 per cent. of FeO the acute bisectrix is $\mathfrak{c}$ (except in monticellite), and with more iron it is $\mathfrak{a}$; in the former case the mineral is optically positive with $\rho < v$, and in the latter negative with $\rho > v$. In the paper, analyses and complete optical determinations are given of the fayalite of Rockport, the hortonolite of Monroe, and of the monticellite of Magnet Cove, Arkansas. L. J. S.

Salvadorite, a new copper-iron-vitriol (W. Herz, *Zeits. f. Kryst.*, XXVI, 16-18, 1896). This was found as an aggregate of bluish-green and blue crystals, cemented together by weathered iron vitriol, in the Salvador mine, Quetena, Calama, Chili. The somewhat indistinct and rounded crystals are mono-symmetric, with $b(010)$, and a prism with an angle of 48°16′; they are often twinned. The plane of symmetry is the direction of perfect cleavage, and is the plane of the optic axes. The extinction to the vertical axis is 52° for Na and 46½° for Tl light; optic axial angle 76° for Na and 87° for Tl about. Analysis of crystals gave:—

	FeO	CuO	SO_3	H_2O	Total
I. (green)	8·49	18·77	27·87	44·65	99·78
II. (blue)	8·59	17·57	28·16	44·31	99·63

Formula, $FeCu_3(SO_4)_3+21H_2O$. Salvadorite thus resembles pisanite in composition and crystalline system, but differs in the crystal habit and angle, in the cleavage, and in the angle of optical extinction; in pisanite the cleavage is $c(001)$, and $b(010)$ is the plane of the optic axes, but the extinction is about 74½° to the vertical axis. The two minerals may be dimorphous, or one may be an isomorphous mixture and the other a molecular compound, perhaps in salvadorite as $1(FeSO_4+7H_2O)+2(CuSO_4+7H_2O)$. L. J. S.

Quiroguite (L. F. Navarro, *Anales Soc. Española Hist. Nat.*, XXIV, Actas 96-100, 1895). This mineral, named after F. Quiroga, occurs with anglesite, siderite, and pyrites at the mines San Andrés, Georgiana, Paraíso, &c. in the Sierra Almagrera, Spain. From the habit of the pyramidal crystals, the system is given as tetragonal, with the forms $a(111)$, $b(100)$, $m(001)$, $c(112)$?, $d(706)$? The measured angles are $111 : 11\bar{1} = 45°52'$, $111 : \bar{1}11 = 80°9'$, ab 49°34′, mc 54½°, md 45½°, cd 35°.[1] Schrauf, who has examined the crystals, suggests that they are probably only galena, in which eight faces of a triakisoctahedron are developed to the exclusion of the remainder, thus forming an acute square pyramid.[2] The basal cleavage is, however, stated to be more perfect than the two which are perpendicular to it; and thermal conductivity experiments are said to support the view that the mineral is tetragonal. Colour lead-grey; Sp. gr. 7·22; H=3. Analysis by F. Soria gave:—

Pb	Sb	Fe	S	Ag	Total
63·89	9·69	6·30	17·51	trace	97·39

From this is deduced $(PbS)_{30}$, $(Sb_2S_3)_1$, $(FeS)_{11}$, or, as pyrites was seen enclosed in the crystals, $(PbS)_{23}$, $(Sb_2S_3)_3$. L. J. S.

Phosphorescent Diamonds: Tiffanyite (G. F. Kunz, *Trans. New York Acad. Sci.*, XIV, 260, 1895). The various colours of diamonds are attributed to the presence of hydrocarbons; and the phosphorescence and fluorescence of certain diamonds are attributed to a bluish-white substance, which is undoubtedly a hydrocarbon, and for which the name tiffanyite is proposed. L. J. S.

Jadeite from "Tibet" (Max Bauer, *Neues Jahrb. f. Min.*, I, 85-95, 1896). Amongst jadeite pebbles from "Tibet in N. Himalayas" four colour varieties are distinguished: (1) snow-white with a tinge of lilac or violet; (2) white with a tinge of grey; (3) white with a greenish tinge; (4) sombre green with blue and grey shades, the green colour being here due to iron, and not to chromium, as in the emerald green spots of the white varieties. The last variety consists of interwoven needles and fibres,

---

[1] From the angle $111 : 11\bar{1} = 45°52'$, the forms c and d are (335) and (305) respectively, and $a : c = 1 : 1·6712$. The last three angles, it will be noticed, are cubic angles.

[2] Schrauf gives the forms as (776), (887), (554), (111), and (221), and refers to his *Atlas der Krystall-formen*, taf. XXXV. fig. 14.

sp. gr. 3·325, and contains veins of white, granular nepheline, of which an analysis is given, sp. gr. 2·628; with the nepheline is a small quantity of basic plagioclase, and enclosed in the grains are needles and prisms of jadeite. We, therefore, have here a jadeite-plagioclase-nepheline rock, in which the nepheline plays the part of the ground-mass, and in which, locally, the relative amounts of the constituents vary very considerably, the larger portion consisting mainly of jadeite, with here and there only a little of the felspar and nepheline. Two of the white varieties also show a little of this felspar and nepheline. Nepheline has previously only been recorded in igneous rocks, and its occurrence in a crystalline schist (viz. jadeite) is new. The low specific gravity given for some jadeites (sometimes below 3) is better explained by the presence of these minerals than by assuming uralitisation; for if the whole of the pyroxene were changed to hornblende, the specific gravity would still be greater than 3. This, together with isomorphous replacement, also explains the variations in chemical composition. L. J. S.

Etching of Calcite (A. Hamberg, *Geol. För. Förh.*, XVII, 53-73, 453-472, 1895; Abstr. in *Neues Jahrb. f. Min.*, 1, Ref. 216-222, 1896). Plates of Iceland spar were cut in various definite directions, and the loss in weight per unit area (or sometimes the reduction in thickness) determined after they had been allowed to remain in hydrochloric acid. The solubility coefficient for any particular face, at any definite temperature, is defined as the amount of calcite in grams dissolved from 1 sq. cm. in one second by hydrochloric acid of specific gravity 1·09. If l_t be this coefficient at $t°$, then at $T°$ it is $l_T = l_t\,(1{\cdot}07473)^{(T-t)}$.

Face.	Coefficient at 0·4°.	Coefficient at 15°.	Coefficient at about 30°.	
OR (111)	0·000201	0·030551	0·00167	0·69
∞R ($2\bar{1}\bar{1}$)	0·000130	0·000335	0·00115	1·02
$\infty P2$ ($01\bar{1}$)	0·000125	0·000278	0·00093	1·00
$-2R$ ($\bar{1}11$)	0·000064	0·000149	0·00061	0·67
$+R$(100)	0·000054	0·000159	0·00072	0·94
$+4R$ ($3\bar{1}\bar{1}$)	0·000140	0·000528	0·00153	—
$-\frac{1}{2}R$ (101)	0·000213	0·000580	0·00164	0·78
$+R2$ ($30\bar{1}$)	0·000237	0·000670	0·00179	—
$+2R$ ($5\bar{1}\bar{1}$)	0·000236	0·000726	0·00197	1·17

The results obtained are the more accurate when solution takes place more quickly. On the easily soluble faces solution proceeds regularly

without the formation of etch figures; but on (100) and ($\bar{1}11$) etch figures are developed, solution having here gone on in the direction of other planes. Confirmatory results were obtained with calcite cylinders cut in various zones.

With more dilute acid, the same maxima and minima occur, but the difference between them is less. Numerous measurements are given, showing the effects of the presence of calcium chloride or sugar with the hydrochloric acid. Acetic acid was also used. The last column in the above table gives the relative solubilities when water containing carbon dioxide under a pressure of six atmospheres is used; here sharp etch figures are developed on the basal plane. L. J. S.

An artificial form of Silica (F. Rinne, *Neues Jahrb. f. Min.*, I, 139-148, 1896). The action of acids on heulandite and the resulting changes in the optical characters are described. When the mineral is placed in anhydrous sulphuric acid the effect is the same as heating to 150°, this having been previously described by the author. Dilute sulphuric acid, or hydrochloric acid, however, completely decomposes the mineral, leaving silica with the form of the heulandite cleavage flakes. This silica shows a negative bisectrix perpendicular to the plate, the magnitude of the optic axial angle varying in different fields; the double refraction is fairly strong. When heated to redness, there is a loss of about 8·8 per cent. of water, but no change in the optical characters. The specific gravity of 2·143 is near to that of tridymite and of cristobalite, but the optical characters differ. L. J. S.

Caswellite, an altered Biotite (A. H. Chester, *Trans. New York Acad. Sci.* XIII, 181-183, 1894). This new mineral from Trotter Mine, Franklin Furnace, N.J., which has the characters of a clintonite, is of a flesh- to light copper-red colour; it has a bronzy lustre, a micaceous structure, and is brittle; H = 2·5-3; sp. gr. 3·54. It is associated with massive yellow garnet (polyadelphite), granular rhodonite, and somewhat altered, dark brown biotite, into the latter of which there is a gradual passage. It is completely decomposed by hydrochloric acid, with separation of gelatinous silica; the mean of two analyses is—

Loss on ignition	SiO_2	Fe_2O_3	Al_2O_3	Mn_2O_3	CaO	MgO	Total
4·64	38·74	6·85	6·58	15·96	22·30	2·52	100·58

This gives approximately the ratio $SiO_2 : R_2O_3 : RO : H_2O = 6 : 2 : 5 : 2{\cdot}5$. The mineral is very feebly doubly refracting, shows no pleochroism, and

has a larger optic axial angle than the biotite from which it has been derived. Unaltered biotite from another part of the mine contains a considerable amount of potassium, much magnesium, and little or no calcium, and it is supposed that the caswellite has been derived by the local action of water, containing manganese and calcium, on this biotite, the alkalies having been carried away. L. J. S.

Precious Opal from White Cliffs, N.S.W. (T. Cooksey, *Record Australian Museum*, II., 111, 1896). The crystalline calcite, which has replaced the calcium carbonate of shells in a ferruginous sandstone at White Cliffs, N.S.W., has itself been replaced by precious opal, which reproduces the cleavages of the calcite. These flat and regular cracks in the opal give rise to the play of colours, that from conchoidal cracks and fractures being subordinate. L. J. S.

Hastingsite, a new Alkali Hornblende (F. D. Adams and B. J. Harrington, *Amer. Journ. Sci.*, [4], I, 210-218, 1896). One of the two hornblendes occurring in the nepheline-syenite of Dungannon, Hastings Co., Ontario, which was in a previous paper mentioned as being allied to arfvedsonite (Abstr. XI, 46), is here described in detail. It has a small optic axial angle (30° or 45°), the plane of the optic axes being (010), and the strong dispersion $\rho > \nu$; the extinction angle is large ($c : c' = 30°$), the double refraction low, and the pleochroism a yellowish-green, b and c deep bluish-green. The chemical analysis is given under I; calculating the titanium with the silicon, this gives the orthosilicate formula $(R_2', R'')_3R_2''Si_3O_{12}$, which is the same as that given by Scharizer for "syntagmatite" in his theory of the composition of aluminous amphiboles. Hornblendes similar to the above occur in the nepheline-syenite at Montreal and at Umptek in the Kola Peninsula.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO
I.....	34·184	1·527	11·517	12·621	21·979	0·629	9·867
II.....	36·604	1·078	9·771	15·996	3·852	1·301	29·306

	MgO	K_2O	Na_2O	Loss on ignition	Total	Sp. gr.
I.....	1·353	2·286	3·290	0·348	99·601	3·433
II.....	1·384	—	—	0·285	99·577	3·739

Under II. is the analysis of a *titaniferous andradite*, which occurs as brown, isotropic grains in the Dungannon rock; calculating the titanium as Ti_2O_3, the garnet formula is deduced. The mineral encloses calcite

(apparently not secondary), hornblende, pyrites, iron ore and nepheline. Similar garnets occur at Montreal, Stokö and Alnö. L. J. S.

Optical Properties of Epidote (E. H. Forbes, *Amer. Journ. Sci.*, [4], I, 26-30, 1896; and *Zeits. f. Kryst.*, XXVI, 138, 1896). The grey epidote of Huntington, Mass., is described in detail, and optical determinations are given of green epidote from the Zillerthal. The results are compared with those obtained by Klein (1879) for the Untersulzbachthal crystals, showing that there is a gradual change in the magnitude of the optical constants (for sodium light) with the amount of iron :—

	Fe_2O_3 per cent.	a	β	γ	$\gamma - a$	2 V over a
(Klein)	14·0	1·7305	1·7540	1·7677(r)	0·0372	73°39′
Zillerthal	6·97	1·720	1·7245	1·7344	0·0144	87°46′
Huntington	5·67	1·714	1·716	1·724	0·010	90°32′

Here, with the decrease of iron, there is an increase in the optic axial angle, until for the Huntington mineral the sign has changed to positive with $\rho < v$. L. J. S.

Method for the determination of the refractive power of a mineral in sections. C. Viola (*Tscherm. Min. Mitth.* XVI. (ii.) 150-4) bases his method on the mode of observation devised by Becke for distinguishing between the more highly refractive and the less refractive minerals in sections. The Becke process consists in regulating the illumination by means of an iris diaphragm above or beneath the polariser, and raising the objective, when a bright strip will be seen on the side of the more highly refractive mineral, and a dark strip on the side of the less refractive mineral. The excess of illumination on the side of the more highly refractive mineral is of course due to the light which has been totally reflected at the boundary. For the eye to be able to appreciate the effect, a certain limit of illumination (obtained by gradually closing the iris diaphragm) is necessary. A simple calculation shows that at this limit of illumination the difference of the refractive indices of two minerals in contact in a section is proportional to the square of the aperture of the iris-diaphragm,

$$\text{Or, } n_2 - n_1 = \lambda D^2.$$

The constant λ is determined by means of minerals of which the refractive indices are known.

By means of this formula, given the refractive index of one mineral (or

of the Canada balsam in which a mineral is mounted), that of the other is obtained by measuring *D*.

The author states that with practice the method gives results correct to the third decimal place. G. T. P.

The Elæolite-Syenite of the Serra de Monchique (K. von Kraatz-Koschlau and V. Hackman, *Tscherm. Min. Mitth.* XVI. 1896, 197-307. One plate and map). In this paper is given a very detailed account of the well-known elæolite syenite massive of Monchique, the dyke rocks connected with it, and its contact effects on the grauwacke and Culm-slates through which it was erupted.

The whole massive, about 60 square kilometres in extent, may be roughly divided into two main types, viz. the normal elæolite-syenite of Picota and the syenite of Foia, much poorer in elæolite, and in many respects very similar to the pulaskite from the Fourche Mountains, Arkansas, described by J. F. Williams (*Ann. Rep. Geol. Survey of Arkansas for 1890*). The coarse-grained elæolite syenite of Picota consists mainly of gray felspar (soda-orthoclase with microcline and albite) and reddish-brown nephelite. Compared with these minerals the darker ferro-magnesian minerals only occur in small amount. These consist of diopside with ægyrine-augite border, biotite and arfvedsonite-like hornblende. Other constituents are sphene, sodalite, fluor (in dark violet grains), lithia-mica, rutile, and apatite; and amongst the decomposition products, cancrinite, zeolites, calcite and muscovite. Låvenite in minute grains and prisms, showing strong pleochroism, occurred very sparingly. In chemical composition the rock approaches very closely the elæolite-syenite of Pouzac, described by Lacroix. The elæolite-syenite of the Foia differs from the Picota mass in its slight content of nephelite; and, although there is probably no sharp boundary line between the two rocks, the Foia mass, from its generally finer grain, appears to have consolidated at a different depth from the Picota.

Near the village of Monchique the Foia rock is most like the Picota, but even there the felspar (mostly moirée-microcline of Brögger) is considerably in excess of the nephelite. This rock passes quickly into one very poor in nephelite, and macroscopically very like the Pulaskites (so-called blue granites) of the Fourche Mountains.

In both the Picota and the Foia masses occur irregular patches of fine-grained elæolite-syenite. On the way from Monchique to Caldas were found considerable masses of an interesting basic rock, which is described as a product of magmatic differentiation due to the contact with the slates.

The rock is very similar to the Teschenite of Moravia, with the difference that it contains nephelite instead of analcite. Between it and the elæolite-syenite there is a quick passage, but no sharp boundary.

In the neighbourhood of the contact the elæolite-syenite was found to undergo the following modification:—The grain changes quickly; the rocks becoming first medium or fine-grained with porphyritic constituents, and then uniformly fine-grained up to almost dense Important changes also occur in the mineral composition. Ægyrine-augite without zonal banding or pure ægyrine takes the place of the ægyrine-augite with zonal banding, but often the pyroxene disappears altogether, and biotite becomes the only coloured silicate. The ores become more plentiful than in the normal syenite, and låvenite, which only occurs exceptionally in the main mass, is generally present on the contact. Confined to the neighbourhood of the contact is also the mineral which was first observed by van Werveke, and it is referred to the pyrrhite of the sanidinite of Sao Miguel.

The dykes which cut the elæolite-syenite are fairly numerous, but generally small, rarely exceeding 2 metres in width. The rocks which form them belong to a variety of types, viz. bostonite-porphyry, tinguaite, nephelite-syenite-porphyry, camptonitic tinguaite and camptonitic monchiquite rocks. Amongst the tinguaites on the south slope of the Picota occurs a peculiar glassy rock to which the authors, on account of its chemical composition, give the name of leucite-tinguaite-vitrophyre, although no leucite could be detected in the rock. The tinguaites are divided into green ægyrine-tinguaites (confined to the Foia) and dark gray ægyrine-mica tinguaites (almost confined to the Picota). A camptonitic tinguaite found at Corte Grande forms a passage to the basic group of dyke-rocks, viz. the camptonitic monchiquites. To the latter group belong rocks which the authors describe under the names of nepheline-tephrite, nepheline-basanite, amphibole-monchiquite, amphibole-biotite-camptonite, fourchite and ouachitite. The analcite found in some of these rocks they regard as pseudomorphous after leucite. [L. V. Pirsson, however, has recently brought forward proofs to show that the so-called glassy base of the monchiquites really consists of analcite, and that the analcite in these rocks should be regarded as a primary constituent (*Journ. Geol.* IV. 1896, No. 6). G. T. P.]

The elæolite-syenite massive is surrounded by a contact zone of metamorphosed grauwackes and clay-slates. These metamorphic rocks consist of quartzose grauwacke, black hornfels and knotted clay-slates. On the borders of the massive were also found metamorphosed eruptive rocks, diabase-hornfels and a cordierite-mica-hornfels. G. T. P.

Elæolite-syenites, phonolites, etc., in Texas. The researches of the Geological Survey of Texas have recently added another to the known districts of nepheline-bearing rocks on the east side of the Rocky Mountains. A. Osann contributes an account of some of these rocks from the Apache or Davis Mountains in the western (trans-Pecos) portion of the State (*Tscherm. Min. u. Petr. Mitth.*, Vol. XV, p. 394). They include plutonic, dyke, and volcanic rocks. True elæolite syenites occur in the Mount Ord range, where they pass through a fine-grained porphyritic modification into a marginal phonolitic facies.

The normal rock consists of felspars, pyroxenes, hornblende, biotite, elæolite, låvenite, magnetite, and apatite. The felspars are partly orthoclase, partly an acid plagioclase, often with microperthitic intergrowths. The pyroxene is chiefly a green augite, passing at the margin of a crystal into ægirine-augite and true ægirine. The elæolite is now wholly replaced by zeolites. Lavenite is constantly present, and is recognised by its high refringence and birefringence and its pleochroism: α and β faint yellow, γ deep wine-yellow; extinction-angle $ac = 16°$ to $18°$. Zircon, on the other hand, is absent.

In the fine-grained porphyritic variety, elæolite and sodalite become prominent constituents, biotite is less frequent, and ægirine increases in quantity at the expense of augite. The felspars become smaller (except the porphyritic crystals), and show some parallel orientation. In the phonolitic facies fresh nepheline is abundant, mica is wanting, and the augite and hornblende are completely replaced by ægirine-augite, ægirine, and arfvedsonite. A mineral identified with ænigmatite is also very frequent. It is transparent only in very thin slices, giving a brown colour with pleochroism: α brown, β and γ "dark red-brown-carmine." This and the other coloured constituents tend to form fibrous aggregates or patches in the ground-mass of the rock. Eudialyte, or an allied mineral, is found in some specimens.

In the Saw-tooth Mountains, to the west of the Apache group, occurs a mass of syenite, passing at its margin into fine-textured porphyritic varieties. The syenite consists of orthoclase and microperthite, augite, brown hornblende, a little biotite, zircon, sphene, iron-ores and abundant apatite. The porphyritic rocks are interesting for the habit of the large felspars, which agree with those of the Norwegian rhomb-porphyries in having the prism and basal planes predominating. In optical properties also they correspond, and they contain soda as well as potash. An analysis of the syenite given below (I.) is probably too low in alumina and too high in alkalies, but gives a general idea of the composition of the rock.

An ægirine-syenite from Mosquez Cañon and an clæolite-syenite from Paisano Pass are also described.

The dyke-rocks associated with the above plutonic masses include the tinguaite and bostonite groups found in like association in other districts and a third, more acid, to which the name "paisanite" is given. The tinguaites are divided into three sub-groups; normal tinguaite (with

	I.	II.	III.
SiO_2	59·48	73·35	71·10
TiO_2	0·17	—	0·57
Al_2O_3	13·46	14·38	11·39
Fe_2O_3	6·71	1·96	5·33
FeO		0·34	
MgO	1·64	0·09	1·54
CaO	1·83	0·26	0·08
Na_2O	11·67	4·33	3·95
K_2O	6.03	5·66	6·37
H_2O	0·20	—	0·44
			P_2O_5 0·05
	101·19	100·37	100·82

nepheline), mica-bearing tinguaite, and tinguaite without nepheline. The bostonites, very poor in coloured minerals and in quartz, consisting mainly of felspar, include orthophyric and trachytic types. The paisanites consist essentially of quartz, felspar, and riebeckite. The last occurs in ragged patches with deep blue colour and pleochroism: α dark blue, β rather paler grey-blue, γ pale green with a yellowish tone. A chemical analysis of a typical paisanite from Mosquez Cañon gave the result II, which shows some resemblance to Norwegian dyke-rocks described by Brögger (grorudite, &c.; see p. 115 of this volume). From these it differs mineralogically in having the amphibole-mineral riebeckite instead of ægirine, and also in the mode of occurrence of this coloured mineral. The analysis corresponds to riebeckite 6 per cent., orthoclase 35, albite 32, and quartz 27.

The volcanic rocks of the district include basalts, liparites (rhyolites), and phonolites. At one locality, Limpia Creek, flows of the three are seen to overlie one another in this order. The rocks referred to liparite contain porphyritic crystals of a peculiar sanidine (rich in soda; sp. gr. 2·582) in a ground-mass of quartz and felspar. The only coloured mineral is a little pale green pyroxene, apparently ægirine. A liparite from Fort Davis gave the figures under Column III.

The phonolites are rich in nepheline, which occurs partly in porphyritic crystals in a ground-mass of variable texture. Ferromagnesian minerals are also abundant. The pyroxenes are represented by augite, ægirine-augite, and ægirine. The first, often bordered by the others, is found chiefly in the more coarse-grained rocks, in the finer ones the border of soda-bearing pyroxene is increased at the expense of the augite-nucleus. Of the amphibole minerals the coarser rocks contain chiefly a brown hornblende (a = pale brown to yellow-brown, β = dark brown, γ = dark green to green-brown; extinction angle *ca* 15°). This is replaced in the finer textured rocks by a blue amphibole like the catoforite of Brögger, *l.c.* (a = dark green-blue to pure steel-blue, β = dark brown-grey, γ = faint yellow-brown; extinction angle *ca* over 20°). Both minerals occur in fibrous aggregates, and ænigmatite is found in the same habit.

The age of all these rocks is not known, further than that they are post-carboniferous. The "consanguinity" of the whole series is very clearly indicated, and the numerous points of resemblance between these rocks and those of the Christiania basin are of special interest. A. H.

Nepheline-syenite of Alnö (A. G. Högbom, *Geol. Fören. Stockholm Förhandl.* XVII. 2 and 3, 1895). The nepheline syenite of Alnö and rocks related to it are confined to the north-east and north part of the island. The most interesting feature of this syenite region from the theoretical point of view is the remarkable way in which a limestone, rich in minerals, is associated with the syenite. This limestone has not the characters of a metamorphosed sedimentary rock. The minerals which it contains have been formed at the expense of the syenite magma, and where these fail the rock consists of almost chemically pure calcium carbonate. Whatever may be the origin of this limestone, all the author's observations tend to the conclusion that it has been fused and taken up by the magma without decomposition, and that in the solidification calcite has crystallised out of the magma in precisely the same way as the other minerals. The numerous occurrences of primary calcite in the eruptive rocks of this region, the pegmatitic intergrowth of calcite with nepheline, ægirine, felspar, &c., all help to support this idea. The possibility of the existence of calcium carbonate in the magma may have been due to the slight acidity of the nepheline-syenite magma, which offered no excess of silica for the decomposition of the calcite, and to the high pressure under which solidification of the rock took place. The author is, therefore, inclined to regard this limestone, so closely connected with the nepheline-syenite and so rich in syenite minerals, as a product of the

differentiation of the magma, rich in lime and carbonic acid, in the same way as the other differentiated rocks of this region.

The contact phenomena between the nepheline-syenite and the surrounding gneiss also offer some points of interest. Although there can be no real passage of one of these rocks into the other, yet the line of junction is often difficult to fix. Against the gneiss the syenite loses its nepheline, becomes somewhat schistose, and, by the addition of biotite, gains a very gneiss-like appearance. On the other hand, the gneiss along the junction is also altered. The amount of quartz diminishes, the gneiss minerals are corroded or re-absorbed to give place to others, amongst which are many of the syenite minerals. As regards the age of the nepheline-syenite, all that can be said, in the absence throughout the whole region of younger sedimentary rocks, is that the eruption took place in post-Archæan time, since the rocks show no evidence of dynamic effects such as everywhere characterise the Swedish Archæan rocks.

Connected with the mass of nepheline syenite are numerous dyke rocks. Many of these dykes are of melilite-basalt (alnoite) and of red nepheline-syenite or tinguaite; but there is a remarkable group consisting principally of calcite and zeolites without dark minerals, which the author considers represents the dyke form of the massive limestone just as the alnoite and tinguaite may be regarded as the petrographical equivalents of the basic and acid massive rocks which have resulted from the differentiation of the magma. The author gives detailed and exhaustive descriptions of all the rocks of the district. As regards the nepheline syenite, magmatic differentiation has given rise to a number of differentiation products, to which, however, the author, with commendable restraint, has refrained from giving distinctive names. In a coloured plate the approximate mineral composition (as determined by areal measurements in sections under the microscope) of eight of these differentiation products is graphically represented. They range from a normal nepheline-syenite consisting of orthoclase with nepheline and pyroxene (No. I.) to a very basic rock (No. VIII.), consisting mainly of olivine and magnetite, very similar to the magnetite-olivenites of the hyperite rocks. Besides these differentiation products there is the zone of acid nepheline-syenite along the contact with the gneiss. The felspar of these nepheline-syenites is almost exclusively orthoclase which like the sanidine of some eruptive rocks contains from 1 to 2 per cent. of barium oxide.

Of the more basic differentiation products those which are rich in apatite approximate to the Jacupirangite of Brazil described by O. A. Derby.

G. T. P.

Ancient acid lavas in Massachusetts. J. Sears (*Bull. Mus. Comp. Zool. Harvard*, Vol. XVI, No. 9), has described an interesting rock from Marblehead Neck. It had been already shown by Wadsworth to be an ancient lava-flow, and it now appears to be comparable with the "Keratophyre" of the German petrologists. Porphyritic crystals of felspar are found to be anorthoclase, with specific gravity 2·570 – 2·572 and composition expressed by I. (Analysis by T. Chatard.)

	I.	II.	III.
H_2O at 110° C.	0·04	0·91	1·06
H_2O at red heat	0·37	1·28	
SiO_2 ...	65·66	70·23	73·00
TiO_2 ? ...	—	0·03	—
P_2O_5 ...	—	0·06	—
Al_2O_3 ...	20·05	15·00	15·61
Fe_2O_3 ...	traces	1·99	—
FeO ...	traces	—	1·95
MnO ..	0·13	0·24	—
CaO ...	0·67	0·33	0·79
MgO ...	0·18	0·38	—
K_2O ...	6·98	4·99	0·88
Na_2O ...	6·56	4·98	4·95

The ground-mass consists of minute lath-shaped felspars with quartz, etc., and the bulk analysis of the rock is given by II. A. H.

Ancient acid lavas in Wisconsin. Recent researches have detected in many parts of the United States volcanic rocks of Palæozoic and pre-Palæozoic age agreeing in many respects with those already known in England and Wales. S. Weidman has described some interesting examples associated with the Upper Huronian quartzites of the Baraboo Bluffs in Wisconsin. (*Bull. Univ. Wis., Sci. Ser.*, Vol. I, p. 35, 1895.) Like the Massachusetts rocks noticed above, these are acid lavas with a relatively high content of soda, and may be described as old soda-rhyolites. The author follows German usage in naming them quartz-keratophyre. The porphyritic elements are soda-orthoclase and soda-plagioclase, quartz being rare and deeply corroded: ilmenite, biotite, zircon and magnetite also occur. The ground-mass is a holocrystalline aggregate of quartz and felspar, showing in different examples fluxion, micropœcilitic, and spherulitic structures. A bulk-analysis by C. F. Austin gave the result quoted under Column III. above (with 0·76 of SO_3): specific

gravity, 2·63. Volcanic breccia is in places associated with the lava. Another interesting feature is the conversion of the latter into a sericite-schist by crushing near its contact with the quartzite. A. H.

Ancient lavas and dyke-rocks from New Brunswick. W. D. Matthew contributes to the growing literature of the pre-Cambrian volcanic rocks of the eastern parts of North America an account of the lavas and associated dykes of the so called Huronian in southern New Brunswick. The prevalent type, termed by the author felsite-porphyry, is shown to be identical in essential characters with recent rhyolites, the characteristic structures of the rocks, such as the perlitic, trichitic, and spherulitic, being preserved in various examples in spite of devitrification and other changes. Excepting two occurrences, porphyritic quartz is rare, and the ferro-magnesian silicates are scarcely represented. Fragmental rocks of acid constitution are also abundant, and some contain what are regarded as volcanic bombs. Basic lavas and tuffs are also found, and some lavas of strongly porphyritic character.

A soda-granite of granophyric tendency is also described. It contains apparently anorthoclase, and its coloured constituents are augite and brown hornblende. A bulk-analysis shows the similarity of the rock to that described by U. S. Grant, from Kekequabic Lake, Minnesota.

The dyke-rocks include diorite-porphyrite and camptonite, diabase, and augite-porphyrite. (*Trans. N. Y. Acad. Sci.*, 1894, p. 185.) A. H.

Eruptive rocks from Montana. G. P. Merrill has recently described a collection of rocks from Gallatin, Jefferson, and Madison Counties, Montana, several of which possess special interest (*Proc. U. S. National Mus.* Vol. XVII, p. 637, 1895.) One from near Bozeman, provisionally referred to the basalts, is a compact dark rock, thickly studded with rounded olivines up to 5mm. and smaller green augites. The groundmass is clear and colourless in thin slices, but seems to have little or no glassy base, consisting essentially of imperfect radial spherulitic aggregates, such as are more familiar in acid rocks. The augite proves to be a chrome-bearing diopside (Analysis I. by Eakins). The bulk-analysis of the rock (II. by Chatard) is remarkable for its high percentage of magnesia and other peculiarities: the specific gravity is 2·86.

	I.	II.	III.	IV.	V.	VI.
SiO_2	52·50	46·90	48·95	46·13	46·35	51·83
TiO_2	—	0·41	0·81	0·73	—	0·29
Al_2O_3	2·26	10·17	5·69	4·69	16·41	7·98
Cr_2O_3	1·07	0·33	0·05	0·04	—	0·31
Fe_2O_3	2·05	1·22	1·20	0·73	9·91	1·48
FeO	2·47	5·17	12·11	16·87	not det.	8·28
MnO	trace	0·10	0·08	trace	—	trace
MgO	17·11	20·98	23·49	25·17	18·72	24·10
CaO	21·70	6·20	5·33	4·41	6·14	5·26
Na_2O	0·35	1·16	1·58	0·08	—	0·35
K_2O	0·07	2·04	0·79	trace	—	0·06
H_2O	0·64	1·04 at 120° C. / 4·38 at red heat	0·18	1·38	3·01 (ign.)	0·29 (ign.)
P_2O_5	—	0·44	0·12	0·07	—	0·09
	100·22	100·54	100·54	100·63	100·54	100·43

A hornblende-andesite from near Fort Ellis is noteworthy for the abundance of corroded crystals of brick red dichroic apatite, up to 0·6mm.

A peridotite (wehrlite) from near Red Bluff is a coarse or fine-textured crystalline aggregate of pale green diallage, deep reddish-brown mica, and olivine: III. is a bulk-analysis by Eakins (with NiO = 0·16 and BaO trace): specific gravity 3·37. A hornblende picrite from North Meadow Creek is a holocrystalline aggregate of hornblende (light green to colourless in slices), abundant olivine, pleonaste, iron-ores, and occasional hypersthene. Its specific gravity is 3·35, and an analysis by Eakins gave the figures in column IV. with NiO = 0·09, BaO trace, and S = 0·24. A peridotite (saxonite) from the same district shews under the microscope a dense ground-mass of granular colourless rhombic pyroxene and pale brown hornblende, with a few olivines, iron-oxides, and dull green pleonaste, enclosing phenocrysts of bronzite, etc. An analysis by Merrill gave the result V. the specific gravity being 3·21.

A rock from between Meadow and Granite Creeks is provisionally placed under pyroxenite, consisting of hypersthene and hornblende, and giving the bulk-analysis VI. (Eakins), with NiO = 0·11. The hornblende gave the composition VII. (Merrill). A similar rock differed in containing abundant deep green pleonaste which gave the analysis VIII. (Eakins) with specific gravity 3·89. A pyroxenite of the websterite type, from near Jackass Creek, shews in thin slices a fine granular aggregate of light green diallage and colourless enstatite, with folia of brown mica, and

occasional areas of lime-soda-felspar, indicating a transition to the gabbro type. The rock gave the composition in column IX. (Merrill): specific gravity 3·30.

	VII.	VIII.	IX.	X.	XI.
SiO_2	46·14	0·55	54·12	50·82	54·15
TiO_2	—	—	—	0·59	not det.
Al_2O_3	17·07	62·09	7·91	11·44	18·92
Cr_2O_3	—	2·62	—	0·03	—
Fe_2O_3	8·45	2·10	not det.	0·25	} 6·79
FeO	not det.	17·56	12·87	8.94	}
MnO	—	trace	present	0·19	not det.
MgO	15·01	15·61	16·64	14·01	1·90
CaO	11·70	0·16	6·21	8·14	3·72
Na_2O	1·11	—	0·44	1·79	5·47
K_2O	0·10	—	1·19	3·45	8·44
H_2O	—	—	—	0·58 (ign.)	not det.
P_2O_5	—	—	—	0·20	not det.
	99·58	100·69	99·38	100·49	99·81

A peculiar type of lamprophyre is described from between South Boulder and Antelope Creeks. It contains abundant perfectly formed green augites and olivine in an apparently holocrystalline ground-mass of felspar with abundant brown mica, etc. Analysis X. with BaO=0·06, was made by Eakins, and the specific gravity was found to be 2·96. This rock overlies a micaceous syenite with nearly six per cent. of sodalite and a composition represented by XI. with Cl=0·42 (Merrill). This analysis agrees closely with that of Lindgren's sodalite-syenite from Square Butte, Montana. A. H.

Leucite-bearing rocks in the Lipari Isles. H. Bäckström has recently drawn attention to a hitherto unrecognised type of rock occurring among the varied lavas of the Lipari group of volcanoes. It is represented by the rocks of Vulcanello, the latest member of the group, formed by an eruption in the year 187 B.C. Petrographically it is a leucite-basanite of a type poor in olivine and containing orthoclase. The larger elements are crystals of augite, labradorite, olivine and magnetite while the ground-mass is a holocrystalline fine-grained mass of felspar, pyroxene, and a variable amount of leucite. The lath-shaped felspars are partly orthoclase, partly oligoclase: the pyroxene is of the same kind as that of

the earlier generation. A chemical analysis of one of the rocks gave the result—

SiO_2	Al_2O_3 & Fe_2O_3	MgO	CaO	Na_2O	K_2O	Total.
51·38	26·35	6·02	9·09	4·76	3·33	100·93

The author remarks that a rock of such composition consolidated under intrusive, instead of effusive conditions, would be a lamprophyre rich in mica (*Geol. Fören. i Stockholm Förhand.* Vol. XVIII, p. 155, 1896). A. H.

Metamorphosed gabbros, etc., in the Zermatt district. Saussurite-gabbros and allied types are well known, chiefly in the form of boulders in the Visp and Saas Valleys, and some of them have been described by Bonney and others. A more complete study of the rocks and of their mutual relations is embodied in an "Inaugural-dissertation" by R. W. Schäfer (*Tscherm. Min. u. Petr. Mitth.*, Vol. XVI. 1895). After a general geological account of the district, including the Allalingrat and neighbouring ridges rising above the glaciers, the author proceeds to describe the rocks under the two main divisions of granular and foliated ('flasrig').

He begins with a coarse-textured olivine-gabbro found only as boulders in the moraines in the Allalin glacier. This consists of labradorite (with secondary interpositions of amphibole), rounded grains of fresh olivine, and brown diallage (colourless in thin slices), without apatite or iron-ore. Between olivine and felspar is always interposed a narrow border, consisting of little crystals, partly of amphibole, set normally to the boundary. The olivine and diallage are together about equal in quantity to the felspar, but their relative proportions vary, and the rock thus graduates on the one hand into forellenstein, on the other into a gabbro with only accessory olivine.

Resembling the preceding in grain and structure is the saussurite-gabbro, noticed by several authors; and various intermediate examples illustrate the derivation of this rock from the other. The felspar is replaced here by a hard, compact, extremely fine-grained "saussurite" aggregate, consisting of little prisms of zoisite, with irregular patches of amphibole, and locally talc. The specific gravity of the aggregate was found to be 3·274. The diallage of the olivine-gabbro is pseudomorphed by amphibole, either as deep green actinolite or as grass-green smaragdite rich in rutiles. The olivine is represented by round patches consisting of talc, actinolite and garnet, the last forming the peripheral

part towards the saussurite-aggregates. An interesting point is the occurrence in the talc of little irregular black flakes of ottrelite: pleochroism in sections, α = olive-green, β = plum-colour, γ = yellowish. The saussurite-gabbro shows varieties corresponding with those of the normal rock, as indicated by the dwindling or disappearance of the several constituents, viz. saussurite, smaragdite, and talc-actinolite-garnet-aggregate. Another variety, from the Allalingrat is a saussurite-diallage-rock with red rutile-grains, garnet, and pyrites; the garnet being richly enclosed in the diallage.

Another rock, from the Hinterallalingrat, consists of amphibole and saussurite with garnet, pyrites and apatite. The amphibole is of specific gravity 3·17, gives the flame-reaction of sodium, and has the pleochroism-scheme γ = grey-blue, β = grass-green, α = yellowish. It thus shows an approach to glaucophane, though its extinction angle (11° in a cleavage-flake) is too high for that mineral. The saussurite of this rock consists mainly of new-formed felspar in clear untwinned grains, probably albite. In the moraine of the Allalin glacier occur true glaucophane-bearing eclogites. One consists of amphibole and pyroxene (intergrown), with abundant garnet and accessory minerals. The amphibole gives a sodium-reaction, and its pleochroism is γ = deep sky-blue, β = olive-green, and α = yellow-green. The pyroxene is an omphacite. The eclogite passes into an amphibole-epidote-rock.

Between the granular gabbros and the well foliated rocks ('Grünschiefer') there is a gradual transition through partly foliated and banded ('flaser') gabbros. A type common among the erratics of the Saas valley, and seen in place on the Allalingrat, shows green amphibole and white saussurite. The former is no longer in distinct pseudomorphs after diallage, but has a fibrous and flaky habit, and is embedded in the saussurite. The latter is more distinctly granular or saccharoid to the eye than in the non-banded gabbros. It consists mainly of clear albite, with zoisite and paragonite. The green portion of the rock consists of actinolite prisms, rich in rutile, and some clinochlore. The last-named mineral is more abundant in the more strongly foliated rocks, where it apparently replaces the actinolite.

The structural characteristic of most of the well foliated and schistose rocks is the occurrence of little lenticular white saussuritic patches (consisting of zoisite, felspar and epidote) in a green amphibole-clinochlore-aggregate. Examples are described from the Egginerhorn and Mittaghorn: others from the Strahlhorn and Hinterallalinhorn are rich in garnet and poorer in saussurite. In specimens from the Gletscheralp

clinochlore more or less completely excludes actinolite, and becomes the dominant constituent, while apatite is abundant in irregular grains.

A number of occurrences of serpentine are noted in the district. The chief point of interest here is the occurrence of two monoclinic minerals of the humite family, one brown, the other pale yellow to colourless. They occur either as granular lumps or groups of little grains in the serpentine, or as rounded prisms, 1 cm. long, in masses of crystalline limestone enclosed in the serpentine. The crystals show a polysynthetic twinning parallel to the base. The plane of the optic axes is perpendicular to the clinopinacoid: a clinopinacoidal section gives an extinction-angle of about 30°, and shows the acute, negative bisectrix. The brown variety gives pleochroism: α = pale yellowish, β = rusty brown (reddish yellow), γ = pale yellowish. Its specific gravity is 3·17 to 3·18, that of the pale variety 3·165. Chemical analyses by Jannasch and Locke gave I. for the white mineral and II. for the brown (both corrected for impurities and recalculated to 100).

	I.	II.
SiO_2	33·03	37·80
FeO	3·78	5·70
BeO	1·75	1·03
CaO	7·00	0·10
MnO	0·80	0·76
MgO	50·16	50·88
Na_2O	0·55	0·36
H_2O	2·93	3·34

The formula deduced is $Mg_5[Mg.OH]_2(SiO_4)_3$, the usual fluorine being wholly replaced by hydroxyl. The precise nature of the parent-rock of the serpentine masses is somewhat uncertain, but it was clearly in genetic relationship with the gabbro group.

These gabbros and associated basic rocks constitute a complex intercalated in the gneisses, mica-schists, and limestones of the district, and sharing with these the effects of orogenetic pressure. These effects are seen in the passage of normal gabbro through granular and then foliated saussurite-gabbros to coarsely and at last finely foliated green-schists. The setting up of schistosity is always accompanied by mineralogical transformations, ascribed to pressure, but the converse is not true: witness the massive saussurite-gabbro. The massive and granular, less altered, rocks form the core of the complex, the most metamorphosed types the margins. A. H.

Mica-syenite in Saxony.—J. M. C. Henderson gives an account of certain dyke-like intrusions of mica-syenite at Rothschönberg, near Deutschenbora, in Saxony (*Zeits. deuts. geol. Ges.*, Vol. XLVII, 534, 1895). The rocks consist essentially of felspars (orthoclase and plagioclase in about equal quantities), mica (in one case muscovite as well as biotite), magnetite, and apatite with accessory quartz (in part secondary) and calcite. A chemical analysis gave the result in column I; a specimen from another outcrop gave II.

	I.	II.	III.	IV.	V.
SiO_2	61·40	57·63	60·15	61·35	61·30
Al_2O_3	16·66	16·47	20·20	18·28	17·10
Fe_2O_3	7·46	5·37	12·28	11·49	10·97
MgO	3·65	4·44	0 96	1·98	3·01
CaO	2·08	5·25	0·70	0·84	0·87
Na_2O	4·75	5·15	1·00	1·78	1·79
K_2O	2 93	3·12	3·43	3·55	4·07
H_2O	0·76	0·45	2·89	2·35	1·48
CO_2	1·54	2·14	—	—	—
S	0·20	0·95	—	—	—
	101·43	100·97	101·61	102·32[1]	100·59

Perhaps the most interesting part of the paper is that relating to the metamorphism of the adjacent phyllites. Three analyses were made; III. of the unaltered rock 2 meters from the junction, IV. altered at 1 meter, and V. in contact with the syenite. The quartz of the phyllite was found to decrease on approaching the junction, the three specimens analysed giving respectively 43·38, 38·94, and 34·06 per cent. The combined silica must therefore increase. There is a notable increase in the amount of biotite, which must be formed mainly at the expense of chloritic material. Now comparison of the three analyses shows certain differences, which seem to indicate, in the neighbourhood of the syenite, an accession of magnesia, potash, and soda, and a loss of water. It is not necessary, to conclude, however, that material has been actually introduced into the phyllite from the igneous rock. The removal of alkalies and magnesia from rocks by weathering action is a well-known fact, and the author remarks that this would take effect to a less extent in the metamorphosed rock (with biotite in place of chlorite) than in the

[1] Including 0·70 of MnO.

normal phyllite; so that if immediately after metamorphism these rocks had the same chemical (though different mineralogical) composition ordinary weathering would produce such a difference as is shown by the analyses. A. H.

Peridotites and amphibolites in Piedmont. In a memoir on the geology of the neighbourhood of Finero, C. Porro gives an account of an interesting group of basic and ultrabasic rocks in the district west of L. Maggiore (*Zeits. deuts. geol. Ges.*, Vol. XLVII, 377, 1895). The chief outcrops form a broad belt running north-easterly from Ivrea to Locarno, intercalated among the gneisses of the Western Alps. The rocks themselves divide into (1) peridotites and (2) felspathic amphibolites and pyroxenites.

Of the peridotites some are quite fresh, and consist of olivine to the extent of about 80 per cent. The other minerals are enstatite, rarely diallage, and chrome-diopside, hornblende, biotite, brown chrome-spinel and pleonaste, and in one case corundum.

	I.	II.	III.
SiO_2	41·74	43·12	49·03
TiO_2	0·19	0·20	—
Al_2O_3	1·14	0·63	13·14
Fe_2O_3	5·70	5·95	6·91
FeO	3·09	4·09	8·60
MgO	43·60	41·69	3·67
CaO	0·14	0·78	12·10
Na_2O	0·59	0·88	3·40
K_2O	0·41	0·19	0·24
Ignition	4·77	not det.	1·70
	101·37		98·79

Hornblende is most abundant towards the edge of the peridotite. Columns I. and II. show the results of analyses by Philippi of a slightly serpentinised peridotite and a fresh example, from different localities. By alteration the peridotites have given rise to serpentine-rocks, some containing chlorite, talc and tremolite; and a talc-schist at Finero, consisting of talc and tremolite, has probably also originated from a peridotite.

Among the hornblendic and pryoxenic rocks Porro distinguishes (i.) pyroxene-bearing felspar-amphibolite, (ii.) schistose and partly fibrous

felspar-amphibolite, (iii.) hornblende-bearing felspar-pyroxenite, (iv.) coarsely banded felspar-amphibolite. The first, which occurs in considerable amount, is seen under the microscope to consist of brown hornblende, clear lime-soda-felspar, and subordinate green pyroxene, with red garnet, sphene, rutile, biotite, etc., as accessories. Column III. shows a chemical analysis (mean of two) by Seyfried. This rock passes in places into the schistose variety, poor in felspar, which occurs as a rule as lenticular intercalations in the gneisses which bound the main belt of basic rocks. In this rock the hornblende is green and fibrous. Corundum is a noticeable accessory. Not only towards the gneiss, but also towards the peridotite does the pyroxenic felspar-amphibolite show a marginal modification. Here the structure changes, and pyroxene takes the leading part instead of hornblende. A parallel-structure becomes more marked; grains of garnet, pyroxene and hornblende tend to give a porphyritic appearance to the rock; and the felspar is partly segregated into narrow parallel white bands and lenticular streaks. This is the hornblendic felspar-pyroxenite. Nearer to the peridotite the dark-green bands become more predominant, and the texture is finer. The pyroxene is seldom uralitised, but part of it is converted into chlorite, tremolite and epidote, while part remains fresh, suggesting that two different kinds of pyroxene have been present. In the body of the peridotite itself occur small portions of a rock generally similar to this pyroxenite. The last of the four types, the coarsely banded felspar-amphibolite, occurs as lenticular masses in the peridotite, and, unlike the pyroxenite, it is not very sharply marked off from the ultrabasic rock. The texture is coarse, and the dark hornblendic and light felspathic bands are sometimes more than 30 cm. broad. Pyroxene occurs only sparingly; garnet is often abundant in the dark bands.

All these basic rocks, including the peridotite, are to be regarded as true igneous rocks intruded among the gneisses, and especially between the "Sesia Gneiss" and the "Strona Gneiss," while these latter were still undisturbed; and they have been affected in common with the gneisses by the orogenetic forces. After comparison of the several rocks and special study of their contact-phenomena, the author concludes that the peridotite and the felspar-amphibolite with its varieties come from one original rock-magma, which became differentiated prior to, or at the beginning of, the intrusion into a felspar-amphibolite-magma and a peridotite-magma. These two forced their way in among the gneisses in the order named, though portions of the former magma entangled in the latter separated out later as lenticular masses of coarse felspar-amphibolite in

the peridotite. The chief "contact" effect between the two rocks is the conversion of hornblende to augite in the felspar-amphibolite, which is ascribed to the chemical agency of the peridotite-magma. A. H.

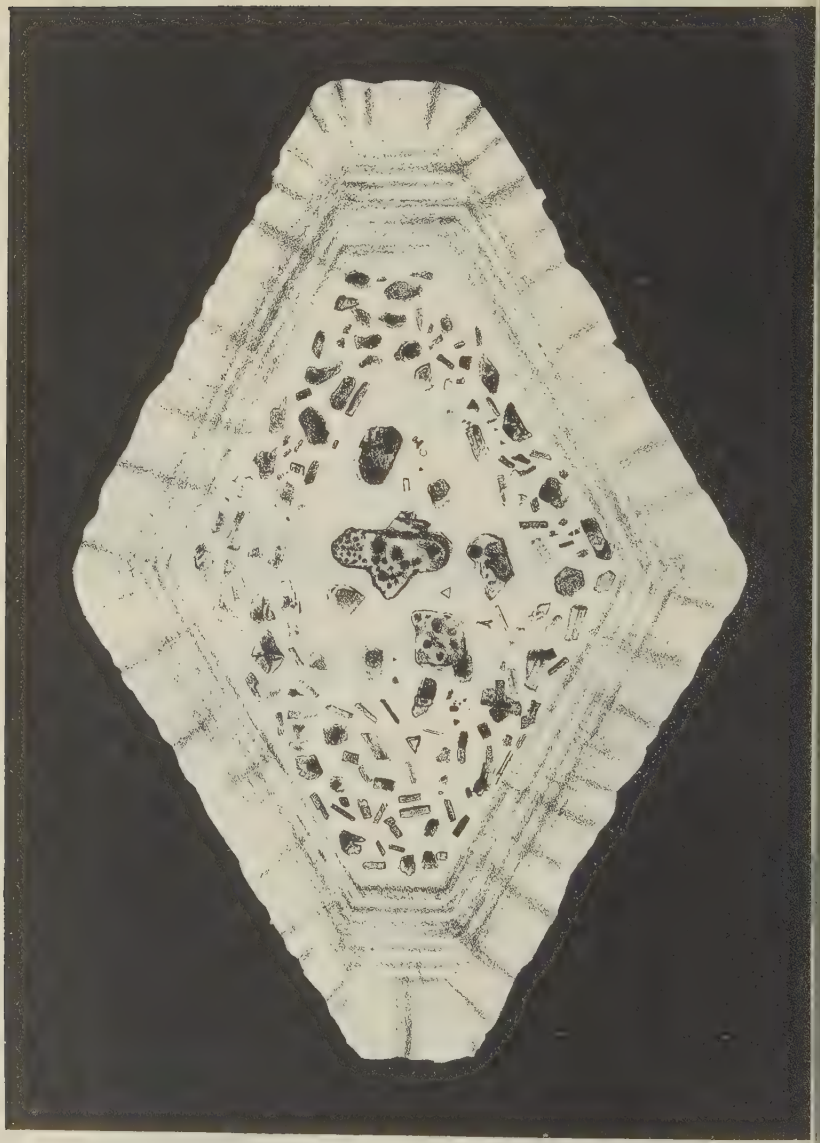
Missourite, a new leucite rock. W. H. Weed and L. V. Pirsson (*Am. J. Sci.* II. 1896, 315-23) describe a new rock type from the Highwood Mountains of Montana. The rock forms an intrusive stock (2½ miles long, and in places half as wide) in cretaceous shales. It is a dark gray, coarse-grained, evenly granular rock, consisting of leucite, augite, olivine and biotite, with apatite and iron ore. The structure is purely granitoid, and all the minerals are wholly allotriomorphic. As regards classification, the rock is the plutonic representative of the leucite-basalts. G. T. P.

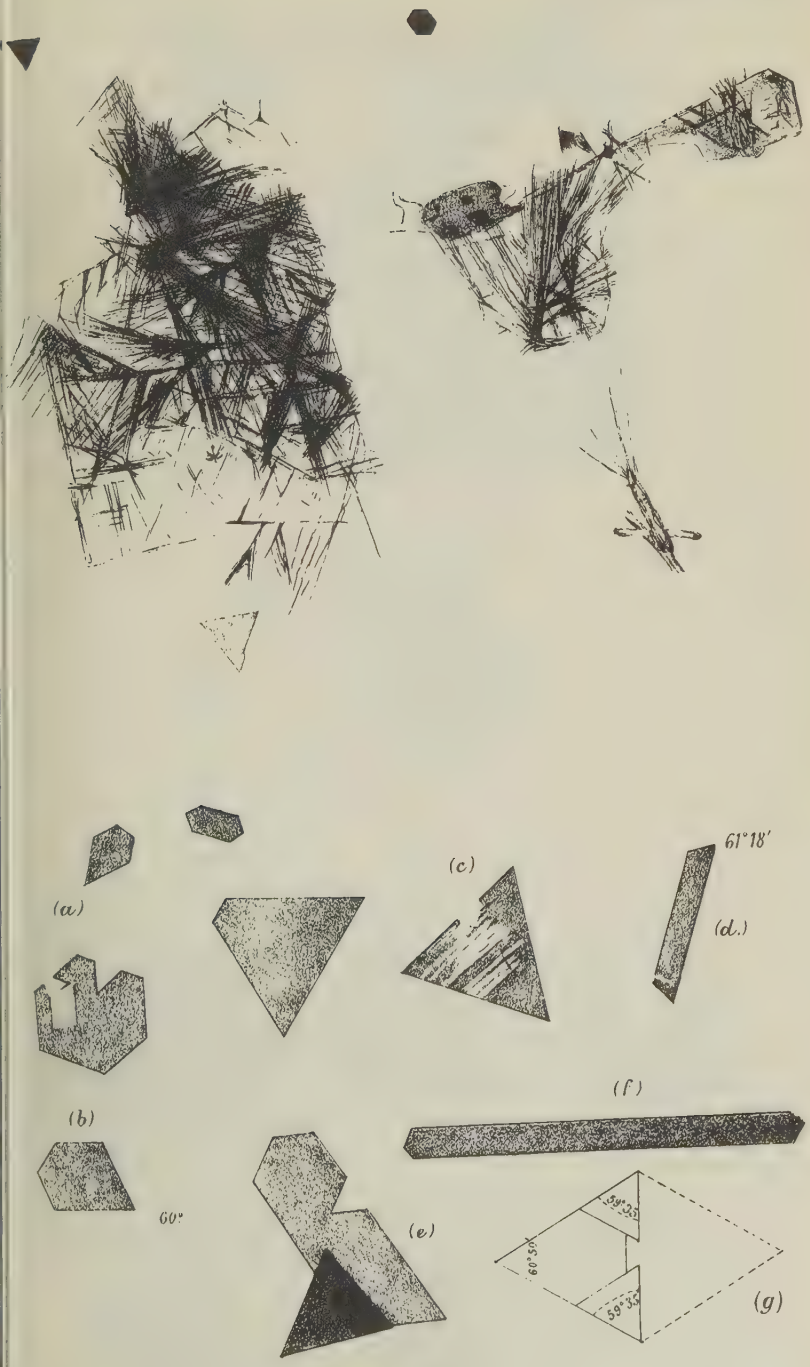
The Monchiquites or Analcite Group of Igneous Rocks. L. V. Pirsson (*Journ. Geol.* IV. 1896, No. 6) brings forward evidence in support of the view that the so-called glassy base in rocks belonging to the Monchiquite group of Rosenbusch consists really of analcite. In the analysis of specimens free from biotite and ægirite, and in which presumably the alkalies, alumina and water were in the base, the molecular ratios of these constituents were as 1 : 1 : 2, as in analcite. In the original analysis of Hunter of the base of the Brazilian Monchiquites, the molecular ratios of silica, alumina, alkalies and water are as 4 : 1 : 1 : 2. The author concludes, therefore, that as the base has the exact chemical composition, the exact specific gravity, the property of gelatinising with acids, and the optical properties of analcite, it must be that mineral, and not a pitchstone glass, as formerly supposed.

The author considers that the analcite in the monchiquites and in many other rocks is a primary constituent, and that as we have a leucite group of rocks, so we must now recognise an analcite group. The analcite-basalts corresponding to leucite-basalts are the monchiquites of Rosenbusch, while the olivine-free analcites corresponding to leucitites are the fourchites of J. F. Williams. G. T. P.

Fig 2.

Fig 3.

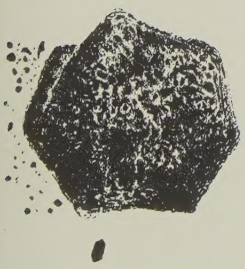



(a)
(b)
60°
(c)
61°18′
(d.)
(e)
(f)
59°32′
60°56′
59°32′
(g)

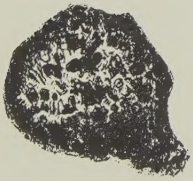
x 27

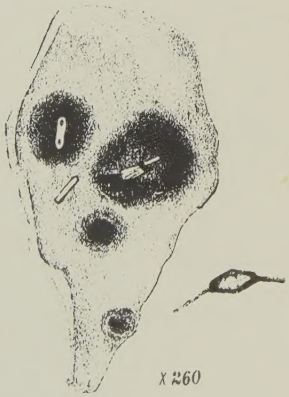
x 70

x 40 (a)



x 20 (b)





x 260

(c)

(d)

CONTENTS OF No. 52.

PAGE

Note on the Occurrence of Rocks allied to Monchiquite in the Island of Fernando Noronha. By G. T. Prior, M.A., F.G.S., Assistant in the Mineral Department of the British Museum 171

On Derbylite, a new Antimono-titanate of Iron, from Tripuhy, Brazil. By Dr. E. Hussak, of the Geological Survey of S. Paulo; and G. T. Prior, M.A., F.G.S., Assistant in the Mineral Department of the British Museum 176

On the Chemical Composition of Zirkelite. By G. T. Prior, M.A., F.G.S., Assistant in the Mineral Department of the British Museum 180

The "Satin Spar" of Alston in Cumberland; and the Determination of massive and fibrous Calcites and Aragonites. By L. J. Spencer, M.A., F.G.S., Assistant in the Mineral Department of the British Museum 184

Zinckenite and Wolfsbergite (Chalcostibite) from Wolfsberg in the Harz; and the Zinckenite Group. By L. J. Spencer, M.A., F.G.S., Assistant in the Mineral Department of the British Museum 188

The Crystallography of Plagionite: New Crystal Forms on Stephanite, Enargite and Anglesite. By L. J. Spencer, M.A., F.G.S., Assistant in the Mineral Department of the British Museum 192

An Occurrence of Prehnite in Wales. By W. Jerome Harrison, Junr. 198

On the Micas of the Three Rock Mountain, Co. Dublin. By Professor J. P. O'Reilly, Roy. Coll. of Science, Dublin 199

On Nemalite from Afghánistán. By F. R. Mallet, late Superintendent, Geological Survey of India 211

Note on Altaite from Burma. By Henry Louis, M.A., A.R.S.M., F.I.C., F.G.S., Professor of Mining in the Durham College of Science, Newcastle-upon-Tyne 215

Notes and Comments 217

Reviews 219

Abstracts 224

ORIGINALLY PRINTED IN GREAT BRITAIN BY MESSRS. WILLIAMS AND STRAHAM, LONDON. REPRINTED OFFSET LITHO BY BIDDLES